PRELIMINARY Health Assessment for

RICHARDSON FLAT TAILINGS

PARK CITY, SUMMIT COUNTY, UTAH

CERCLIS NO. UTD980952840

JULY 24, 1990

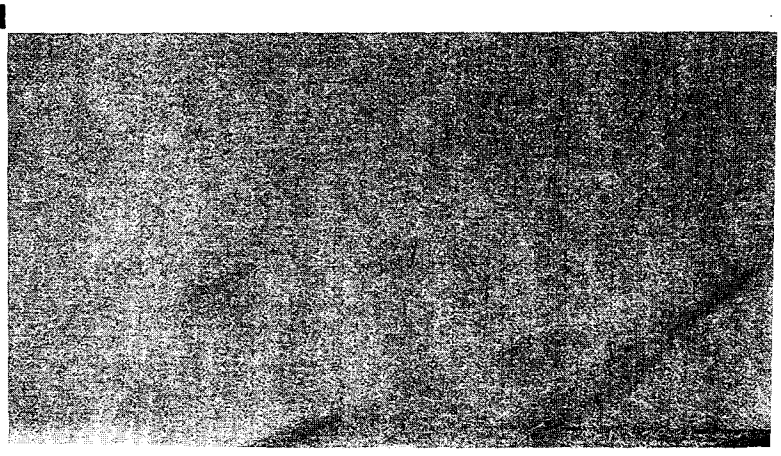
ADDENDUM

JULY 28, 1993

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
Agency for Toxic Substances and Disease Registry

Comment Period Ends :

SEPTEMBER 9, 1993



PRELIMINARY PUBLIC HEALTH ASSESSMENT ADDENDUM

RICHARDSON FLAT TAILINGS

PARK CITY, SUMMIT COUNTY, UTAH

CERCLIS NO. UTD980952840

Prepared by

Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment-Public Comment Release was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6), and in accordance with our implementing regulations 42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate. This document represents the Agency's best efforts, based on currently available information, to fulfill the statutory criteria set out in CERCLA section 104 (i)(6) within a limited timeframe. To the extent possible, it presents an assessment of the potential risks to human health. Actions authorized by CERCLA section 104 (i)(11), or otherwise authorized by CERCLA, may be undertaken to prevent or mitigate human exposure or risks to human health. In addition, ATSDR will utilize this document to determine if follow-up health actions are appropriate at this time.

This document has been provided to EPA and the affected state in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. Where necessary, it has been revised in response to comments or additional relevant information provided by them to ATSDR. This revised document has now been released for a 30 day public comment period. Subsequent to the public comment period, ATSDR will address all public comments and revise or append the document as appropriate. The public health assessment will then be reissued. This will conclude the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

Comments regarding this report are welcome. Please address to:

Agency for Toxic Substances and Disease Registry
Attn: Director, Division of Health Assessment and Consultation (E-32)
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SUMMARY

This document is an addendum to the preliminary public health assessment prepared for the Richardson Flats Tailings site by the Agency for Toxic Substances and Disease Registry (ATSDR) in July 1990.

The Richardson Flats Tailings Site lies in a broad valley northeast of Park City, Utah--approximately 1½ miles from Prospector Square, which is the nearest developed part of the city. The proposed NPL site will include a tailings pond area at Richardson Flats and an adjacent section of Silver Creek where tailings have accumulated. For purposes of this assessment, those areas are considered *on site;* and all other areas *off site.* The site is remote; three occupied residences and three businesses are within 1 mile of the site. Occasional tailings workers and cyclers are among the few who are expected to have visited the site.

Tailings, the source of contamination, are a waste product generated by mining activities. Sampling results have identified a few metals of potential concern. However, people are not being exposed at levels of public health concern in any known completed exposure pathway at the site. Furthermore, it does not appear likely that exposures associated with any past or present potential exposure pathway would exceed levels of public health concern. Finally, blowing dust, the single community health concern expressed, poses no apparent public health hazard. For these reasons, the Agency for Toxic Substances and Disease Registry (ATSDR) has concluded that this site poses no apparent public health hazard in the past or present. However, should the site, or areas near the site where significant levels of contaminants may be found, be developed for residential purposes, contaminant levels would be of public health concern. For that reason, ATSDR considers the Richardson Flats Tailings site an indeterminant public health hazard in the future.

ATSDR's Health Activities Recommendation Panel (HARP) has evaluated the data and information developed in the Richardson Flats Tailings Public Health Assessment. The panel determined that, because of the apparent lack of a public health hazard and community health concerns, no follow-up health activities are indicated at this time.

BACKGROUND

The Agency for Toxic Substances and Disease Registry (ATSDR), in Atlanta, Georgia, is a federal agency within the U.S. Department of Health and Human Services and is authorized by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) to conduct public health assessments at hazardous waste sites. ATSDR has, under this mandate, evaluated the public health significance of this site.

This document is an addendum to a preliminary public health assessment prepared in July 1990 for the Richardson Flats Tailings site (RFT site) by ATSDR after the U.S. Environmental Protection Agency (EPA) first proposed the site for the National Priorities List (NPL) on June 14, 1988 (USEPA 1992b). A copy of the previous health assessment is provided in Appendix C. In February 1991, in response to public comments on its proposed listing, EPA reevaluated site scoring and withdrew the site from consideration for the NPL. EPA again proposed the site for the NPL in February 1992 after modifying its Hazard Ranking System and obtaining new site information. Therefore, in response to our legislative mandate, ATSDR has prepared this preliminary public health assessment addendum that reevaluates available site-related information and relevant public health issues.

A. Site Description and History

The RFT site lies in a broad valley northeast of Park City--approximately 1½ miles from Prospector Square, which is the nearest developed part of the city. Figures 1 and 2 (Appendix A) show features of the vicinity and site. ATSDR's discussions with EPA indicate that the proposed NPL site will include a tailings pond area at Richardson Flats (Area A on Figure 2) and an adjacent section of Silver Creek where tailings have accumulated (Area B on Figure 2). Thus, for purposes of this assessment, Areas A and B are considered *on site*; and all other areas *off site*. Area A is enclosed within the security fence shown in Figure 2; Area B parallels the fence and is immediately outside it.

NPL Site Components

Tailings Pond

The tailings disposal pond covers approximately 160 acres; tailings are as much as 10-feet thick (USEPA 1992a). The pond has not been used since mining activity stopped in 1982. During a site visit in 1992, ATSDR observed that the disposal area is essentially flat and may nearly have reached its practical

storage capacity. No water was ponded at that time. Most of the tailings are covered with soil or a dense growth of a salt grass that has a thick root mat (E&E 1992).

The owner, United Park City Mines (UPCM), reported to ATSDR that tailings were present when they purchased the property in 1953. UPCM reports that their property boundary extends beyond the fence shown on Figure 2; however, the boundary was not defined for ATSDR. Under UPCM's ownership, most of the tailings were disposed between 1969 and 1982 from mines that were owned by UPCM and leased by Park City Ventures and Noranda Mining, Inc. (USEPA 1992a, USEPA Undated). Tailings were transported from the mine sites by slurry pipeline; UPCM reports that one to two people were present at the site to monitor the delivery. EPA reported rumors that, in earlier years, tailings were transported to the site via Silver Creek. UPCM reports that water from tailings transport, surface water runon, and snowmelt were contained within the pond and eliminated through evaporation rather than discharged to Silver Creek. UPCM reports it intends to maintain its mines, the tailings pipeline, and the tailings disposal area and reuse those facilities when mining again becomes economically viable. UPCM reports they will not develop the property for other use.

A Utah Department of Environmental Quality (UDEQ) representative reported rumors that some tailings had been removed and used off site for sewer and road construction. UPCM said there has been no activity of that nature since 1981; although, there may have been earlier. Because off-site tailings use, locations, and human exposure potential are so uncertain, ATSDR cannot address this issue.

In 1974, plans were approved for Park City Ventures to construct an embankment and perimeter dikes to contain the tailings and associated transport water (E&E 1989). A diversion ditch was excavated on site to route runoff water around the tailings impoundment. The ditch begins east of the tailings, crosses the southern part of tailings, and ends in a marshy area of about 10 acres near the embankment. The ditch was excavated through zones of tailings (USEPA 1991b). In 1992, ATSDR noted that ditch slopes were being regraded and covered with soil to reduce erosion and off-site transport of tailings.

In June, 1985, an EPA contractor obtained photographs of clouds of fugitive dust moving off site as a result of strong winds (E&E 1987a). UPCM said they began placing soil over the tailings and planting vegetation in 1983. In 1992, UPCM estimated that they had covered about 85% of the tailings area and that the tailings should be completely covered with soil in 1993 (E&E 1992). An EPA contractor reports that UPCM intends to place soil on the

small part of the tailings area that currently has no soil cover or salt grass. The contractor expressed concern about future dust because some of the cover soils are thin (less than 6 inches thick) and salt grass may disappear if the site becomes drier. UPCM reports most cover soils are being excavated from higher ground northeast of the tailings deposit. ATSDR was informed that the workforce consists of two to four persons who are provided with respirators to use during dry, dusty weather. Haul roads are watered during such weather.

The fence that encloses the tailings deposit was constructed recently. ATSDR observed that gates were locked. Before erecting the fence, motorcyclists and cattle were reported on the property (ATSDR 1990, E&E 1987a). Sheep have been observed on adjacent property.

Silver Creek Flood Plain Tailings

Large floodplain tailings deposits are reported to exist upstream of the site as well as downstream to as far as the confluence of the Weber River (USEPA 1993). An EPA representative reports that the agency has not yet determined the linear extent of the Silver Creek flood plain that will be part of the proposed NPL site. For this assessment, ATSDR defined Area B in Figure 2, which includes two tailings deposits EPA has already investigated. The specific source(s) of those tailings is not known, but ATSDR's review of area topography suggests that their origin is upstream in the watershed, not UPCM's tailings pond.

NonNPL Elements

Park City Sanitary Landfill

UPCM property also contains a closed Park City sanitary landfill; EPA reports that the landfill is not part of the proposed NPL site.

A Park City representative reports the landfill was opened in 1973 and closed in 1985. Wastes were deposited below ground in trenches and also were mounded above ground. An EPA contractor told ATSDR that the landfill materials are mostly sanitary wastes, but are believed to include some tailings from Prospector Square, and sketchy information suggests some chemical wastes like PCBs and paints might be present. City officials have said that the materials placed in the landfill materials are sanitary wastes, and the absence of substantive industry makes it unlikely that chemicals are present other than those that are used in households. During part of the operation, Park City had a policy prohibiting disposal of electrical transformers, hazardous waste, or toxic substances. In 1990, a relocation of U.S. Route 40

resulted in that highway being constructed through the middle of the landfill. ATSDR was told that wastes encountered in the path of the highway were excavated, placed on the adjoining landfill remnants, and covered with soil. Figure 2 shows the approximate limits of the landfill remnants.

Laboratory data were reviewed for samples taken from borings drilled at the landfill during highway development planning (UDT 1989). These data showed that a few inorganic elements detected were not at high concentrations, and no polychlorinated biphenyls, pesticides, or semivolatile organic compounds were detected. One volatile organic compound was detected in two samples at extremely low concentrations (maximum of 0.03 parts per million [ppm]). In addition, although landfill workmen are likely to have been exposed to waste-related contaminants in the past, no exposure is plausible now, and none is expected in the future unless the landfill is disturbed. The city does not intend to reopen the landfill; Summit County provides a landfill for the Park City area at another location. Also, UPCM reports that their property, including the part where the landfill is located, will not be developed.

Based on the information about the landfill and its operation, ATSDR is excluding the landfill and its workers from further evaluation in this public health assessment.

Prospector Square, Silver Maple Claims

Prospector Square, a large residential and commercial development in the northeast part of Park City, was partially constructed on a large deposit of mine tailings. Prospector Square is along Silver Creek about 1½ miles upstream from the RFT site (Figure 1). In 1988, ATSDR conducted a human exposure study to determine the effect of mine tailings contaminated with lead, arsenic, and cadmium on biological levels of those metals among persons living in the immediate vicinity (ATSDR 1988).

Silver Maple Claims, another location along Silver Creek at which tailings are reported, lies upstream from the RFT site, between the site and Prospector Square. The specific location and boundary of Silver Maple Claims has not been defined.

Although some contaminants released at Prospector Square and Silver Maple Claims might migrate to the RFT site, ATSDR review of available information indicates that the RFT site is not likely to have a definable impact on either of those locations. Therefore, ATSDR will not further evaluate contamination or health issues potentially associated with those locations.

B. Site Visit

ATSDR representatives--Ms. Stephanie Prausnitz and Messrs. Don Gibeaut and Glenn Tucker--visited the site area on August 18 and 19, 1992. A public availability session was held on the morning of the 19th. With the exception of representatives of UPCM and the press, no community members attended the meeting. Pertinent information obtained during that visit is described in appropriate sections of this document.

C. Demographics, Land Use, and Natural Resource Use

Demographics

The site is in a rural area with scattered residences. Four homes and three businesses are within a mile. The four homes are approximately ½ a mile southwest (upstream) from the RFT site and are within 100 to 400 feet of Silver Creek. During the site visit, ATSDR observed that one of the residences appeared to be vacant. Two concrete and aggregate suppliers and an electric power company service center are near Silver Creek about ⅛ mile northwest (downstream) of the site. ATSDR learned the businesses employ a total of 51 persons. The nearest residence to Silver Creek downstream from the RFT site was observed to be about 4 miles away.

Nearby Park City is a center for skiing and recreation; its full-time population is about 4,500 (USBC 1991). The census also identifies 3,800 vacant housing units in the city; thus, when the units are filled with visitors, the total population increases substantially. EPA reports that about 4,300 residents are within a radius of 3 miles of the site (USEPA 1991b). The nearest residents within the city are at Prospector Square. The nearest schools in the city are on Route 248, next to Prospector Square. A hospital is also in Prospector Square, but no nursing homes are in the site vicinity.

Land Use

Essentially all of the area within a 1-mile radius of the site is open, undeveloped rangeland that supports generally low-density populations of sheep, cattle, and horses. Beyond 1 mile of the site, land use is principally open, undeveloped rangeland except for development associated with Park City, skiing, and residential and commercial development along a narrow zone by I-80, which is about 4 miles north of the RFT site (Figure 1). Park City officials report they expect future development will extend northwest of town along State Route 224 (Figure 1), rather than along Route 248 toward the RFT site.

The county extension agent reported that there has been limited agriculture, consisting of about 200 acres of pasture, in Silver Creek watershed between the site and I-80. Pasture in that area is primarily grasses and some alfalfa. Stock in this watershed segment includes a dairy herd, beef cattle, and sheep. The dairy cattle are near I-80. Some grain is being raised farther north in the watershed near the community of Wanship, which is about 6 miles beyond I-80.

Natural Resource Use

Mining

The Park City area was once a major lead- and silver-mining district, but mines have not been active recently (UDNR 1986).

Surface Water

Average annual rainfall in the Park City area ranges from 16 inches at low altitudes to more than 40 inches in the Wasatch Mountains, a few miles west of the site. The Silver Creek watershed drains an area of about 26 square miles. The creek originates south of Park City and flows generally northward through the city, passes the RFT site, and discharges into the Weber River about 10 miles downstream from the site. Silver Creek is a perennial stream with an average annual discharge of 3.3 cubic feet per second (cfs) (USEPA 1991b). Flow, however, is quite variable; substantially greater flow occurs during snow melt, and ATSDR observed essentially no flow velocity at the RFT site in August. Weber River, which has an average annual discharge of 214 cfs, is a major stream in the region and discharges into Great Salt Lake about 50 miles downstream of the site (USEPA 1991b).

The on-site diversion ditch receives surface runoff from land areas that are upgradient of the tailings deposit and transports that water through the southern edge of the tailings to a wetland area of about 10 acres by the embankment (USEPA 1991b). From there, the runoff enters Silver Creek at a point ATSDR observed a few hundred feet northwest of the embankment.

Silver Creek is not used for human water supply (E&E 1985). Stock obtain water directly from the creek and from diversion ditches. Creek water is also withdrawn for stock watering and irrigation. Utah Division of Water Rights reports there are three diversions of Silver Creek water downstream from the RFT site (UDNR 1992). The nearest diversion is at the G.M. Pace Ditch that begins about 600 feet north of U.S. Route 189 (US-189) (UDNR 1992). Based on discussion with a Park City official and other information, it appears that G.M. Pace ditch also receives

water directly from the Pace Homer ditch, which originates at a spring in Park City (E&E 1987b). Water from G.M. Pace ditch has been reported to be used for irrigating 316 acres of pasture (USEPA 1991b). The next closest diversion is north of I-80, about 7 miles downstream from the site; water is reported to be used for livestock (UDNR 1992). The third diversion, reported to be for irrigation, is farther north of I-80, about 9 miles downstream from the site and about 2 miles upstream from Wanship where Silver Creek discharges into the Weber River, a major water course in the region (UDNR 1992).

Weber River has only one diversion for public water supplies, at a point about 45 miles downstream from the site: UDEQ reports there are many diversions for irrigation and livestock watering (UDEQ 1992a).

Fishery

Electroshocking data obtained from Silver Creek in 1970 did not show the presence of game fish. Biologists, more recently, report cutthroat trout in the creek; although, there is no information to quantify the population or the location where the trout are present (E&E 1991a). The Weber River is an important trout fishery.

Groundwater

Groundwater exists in both consolidated rocks and unconsolidated valley fill (soils) (UDNR 1986). Consolidated rocks crop out over most of the Park City area, except along stream channels where unconsolidated valley fill is exposed at the surface. Valley fill is primarily alluvial or glacial in origin and consists of clay, silt, sand, gravel, cobbles, and boulders. The alluvium is primarily in low areas, along stream channels. The average thickness of valley fill in the Silver Creek drainage system is about 100 feet.

Silver Creek is flanked by lines of hills that rise a few hundred to 1000 feet above the valley floor. The valley floor slopes downward in a generally northerly direction, the direction of flow in Silver Creek. The RFT site lies along Silver Creek in an area that is blanketed by unconsolidated fill. The thickness of that soil zone at the RFT site is not known. EPA reports that groundwater has been encountered at relatively shallow depths at the RFT site, but a specific depth has not yet been defined. ATSDR believes that water levels beneath the site might be relatively high during wet periods of the year and may drop during drier months.

Water in consolidated rocks moves along faults and fractures from high altitudes toward discharge areas at lower elevation. Studies show that groundwater in valley fill flows in the same general direction as the streams (UDNR 1986). According to studies, the creek gains water inflow over time from the valley fill aquifer system. During dry periods, ATSDR believes that parts of the creek discharge surface water to the valley fill aquifers; although, seepage studies along the creek did not show any areas of significant losses.

UPCM reports there has never been a groundwater supply well on the property. The three residences that are within a mile of the site obtain potable water supplies from private wells that appear to be hydraulically upgradient from the RFT site. It is unknown whether the wells draw water from a valley fill aquifer or from bedrock. The three businesses to the northwest use bottled water for drinking and obtain industrial water from wells that are hydraulically downgradient from the RFT site (E&E 1991d). These wells are reported to be more than 300 feet deep and are probably drawing from a bedrock aquifer rather than from a valley fill aquifer.

ATSDR learned that Atkinson Special Improvement District, High Valley Water Company, and Summit County Service Area #3--serving 240, 250, and 75 persons, respectively--obtain their water from wells in the Silver Creek watershed downgradient from the site. The wells are about 2, 3½, and 4 miles, respectively, from the RFT site and are set back about ¾ to 1 mile from the creek. Park City's public water system gets its supply for its 4,500 residents and many visitors from wells and tunnels that are 1½ miles, or more, upgradient from the RFT site (UDEQ 1992a).

D. Health Outcome Data

Utah maintains birth and death certificate databases and a tumor (cancer) registry. No health outcome data were requested, as discussed in the Health Outcome Data Evaluation section below. In 1988, ATSDR conducted a human exposure study to evaluate whether mine tailings contaminated with lead, arsenic, and cadmium had an effect on biological levels of those elements among persons living in the immediate vicinity (ATSDR 1988). The study results are described in the Health Outcome Data Evaluation Site section below. No additional relevant databases or health studies were identified.

COMMUNITY HEALTH CONCERNS

ATSDR staff noted community members' concern about dust blowing off site. Staff are unaware of any other site-related community health concerns. No health concerns were expressed to ATSDR representatives at the Public Availability session. Furthermore, ATSDR staff contacted residents of nearby houses and representatives of the EPA, UT Department of Environmental Quality, UT Department of Health, Summit County Health Department, and the town of Park City. Concern had been expressed about blowing dust. No one was aware of any other site-related community health concerns.

ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS

ATSDR's preliminary public health assessment of 1990 used sampling data obtained in 1985 and 1986 and addressed several inorganic contaminants: arsenic, cadmium, chromium, copper, lead, manganese, selenium, and zinc. This addendum considers that sampling data in addition to more recent data and site-related information.

Sampling data and supporting site-related information suggest that contaminants have been released into the air, groundwater, surface water, and sediment on and off site. This section identifies contaminants of potential concern that have been selected for further evaluation in subsequent sections of this public health assessment to determine whether exposure to them has public health significance. Identifying contaminants in this section does not imply that exposure will result in adverse health effects.

Contaminant selection considers the following factors:

1. concentrations of contaminants on and off site,
2. sampling plan design, field data quality, and laboratory data quality,
3. relationship of on- and off-site concentrations to public health assessment comparison values for noncarcinogenic health endpoints and for carcinogenic end points, and
4. community health concerns.

ATSDR also conducted a search of the EPA Toxic Chemical Release Inventory (TRI) to determine whether that database identifies any chemical releases for the RFT site or other facilities in the vicinity. TRI contained no data for any facilities in Summit County.

The contaminants of potential concern selected to be addressed further in the public health assessment are listed in each of the data tables (Appendix B), and many are discussed within this section. The data tables contain several abbreviations that identify sources of public health assessment comparison values:

* EMEG Environmental Medial Evaluation Guide
* RMEG Reference Dose Media Evaluation Guide
* CREG Cancer Risk Evaluation Guide
* LTHA Lifetime Health Advisory Guide
* AL Action Level

EMEGs are estimated comparison concentrations that are based on information determined by ATSDR from its Toxicological Profiles for specific chemicals. RMEG comparison values are based on EPA's estimates of the daily exposure to a contaminant that is unlikely to cause adverse health effects. CREGs are estimated comparison concentrations for specific chemicals based on an excess cancer rate of one in a million persons and are calculated using EPA's cancer slope factors. EPA's LTHA identifies the contaminant level in drinking water at which adverse health effects would not be anticipated over a lifetime. All of the foregoing comparison values are guides and do not have a regulatory basis. An AL comparison value is an EPA regulatory concentration that, if exceeded, requires public water systems to initiate specific actions.

Groundwater, tailings, soil, surface water, sediment, and ambient air have been sampled. No data are available for food chain elements.

A. On-site Contamination

Groundwater: Area A

Several samples of groundwater obtained from monitoring wells installed next to the tailings pond and next to the landfill have been analyzed. Data for unfiltered samples show that several of the contaminants of potential concern were found at levels that exceed ATSDR's comparison values for drinking water use--antimony, arsenic, barium, beryllium, cadmium, copper, lead, manganese, silver, vanadium, and zinc. Maximum concentrations are shown in Table 1 (Appendix B). Several of those maximum concentrations were detected at a monitoring well near the

landfill. Review of data for wells at the landfill shows that waste materials there contribute metals to the groundwater. Concentrations for other monitoring wells on site were compared with groundwater data for a monitoring well upgradient from the site, south of the County Road. That comparison suggests that at least part of the contaminants in on-site groundwater in Area A are from tailings.

Tailings Deposits: Areas A and B

Several tailing samples were analyzed from Area A and two from Area B. Maximum concentrations of substances are presented in Table 2 (Appendix B). Arsenic, beryllium, and cadmium were present at levels that exceed ATSDR's comparison values for incidental ingestion. In addition, lead, zinc, and calcium were at especially elevated levels.

Soil Cover Layer On Tailings: Area A

Five samples of the soil cover layer in Area A were analyzed. No sampling has been conducted on site for natural soils at or beyond the perimeter of the tailings deposit. Maximum concentrations of substances are presented in Table 3 (Appendix B). Arsenic and beryllium slightly exceed ATSDR's comparison values for incidental ingestion, but the concentrations detected are typical of soils in the western part of the country.

Surface Water: Area A and Area B

Seventeen surface water samples from the diversion ditch and marsh at Area A and 10 samples from Silver Creek at Area B were analyzed. Because water quality varies with changing flow rates, the sample data may not be indicative of conditions over time. Maximum concentrations of substances are presented in Table 3 (Appendix B).

Many of the substances were detected at levels that exceed ATSDR's comparison values for drinking water. For Area A, the substances include antimony, arsenic, barium, beryllium, cadmium, copper, lead, manganese, mercury, silver, thallium, vanadium, and zinc. At Area B, antimony, arsenic, beryllium, cadmium, mercury, silver, thallium, and vanadium exceeded comparison values; the concentration of lead was identical to its comparison value.

Sediment: Area A and B

Maximum concentrations of substances found in sediment samples from Areas A and B are presented in Table 5 (Appendix B).

Twelve samples taken in Area A from the diversion ditch, marsh, and areas where water ponds on the tailings were analyzed. Arsenic, beryllium, cadmium, and manganese were present at levels that exceed ATSDR's comparison values for incidental ingestion. Lead was found at an elevated level; antimony, iron, and zinc are also elevated when compared to their concentrations in the soil cover data presented in Table 3.

At Area B, two samples of sediment from Silver Creek were analyzed. Arsenic and beryllium were found at levels that exceed ATSDR's comparison values for incidental ingestion. Lead was present at an elevated concentration; antimony, iron, and zinc are also elevated.

Ambient Air: Area A

Ambient air sampling was conducted in 1986 at four locations within Area A. Because of the short sampling duration, the data may not be representative of air quality over time. The samples were analyzed for arsenic, cadmium, lead, and zinc; maximum concentrations reported are presented in Table 6 (Appendix B). The concentrations for arsenic and cadmium exceed ATSDR's comparison values for ambient air. Lead and zinc also occurred at levels greater than would be expected in a rural setting.

Ambient air sampling was also conducted in 1992 at locations along the security fence. These results are described in the next section.

B. Off-site Contamination

Groundwater

Background Monitoring Well and Nearby Industrial Wells

Analytical results for unfiltered groundwater samples obtained from the monitoring well south of County Road, upgradient of the property, and from three nearby downgradient industrial wells are presented in Table 7 (Appendix B).

Data for two samples from the monitoring well show that arsenic, beryllium, and lead exceed ATSDR's comparison values for drinking water. Other substances are not at extraordinary concentrations.

Samples from the nearby industrial wells, which are not used for potable water supplies, were analyzed only for arsenic, cadmium, chromium, and lead. Results for seven unfiltered samples suggest that arsenic and lead are present at levels that exceed ATSDR's comparison values for drinking water (E&E 1992).

Public Water Supply Wells

Analytical data were reviewed for a few unfiltered groundwater samples from three public water supply wells (Atkinson Special Improvement District, High Valley Water Company, Summit County Service Area #3) located on the flanks of the downstream area of the Silver Creek watershed. Maximum concentrations are shown in Table 8 (Appendix B). Several contaminants of potential concern were not reported in analyses of the samples, including; aluminum, antimony, beryllium, cobalt, thallium, and vanadium. ATSDR's comparison values for drinking water were exceeded only for arsenic, which was present at low levels in the samples from the High Valley and Summit County Service systems. Other substances were not at extraordinary levels.

Soils

Five samples of surface soils and two of subsurface soils were obtained near the site. Four of the surface samples were from 2 to 50 feet from roads; the fifth sample location was about 400 feet south of the county road. Maximum concentrations are shown in Table 9 (Appendix B). For surface soils, arsenic and beryllium were present at levels greater than ATSDR's comparison values for incidental ingestion. Lead and zinc were elevated in the sample obtained south of County Road, and vanadium was elevated in one of the other surface samples. The subsurface samples did not contain any substances at extraordinary levels; although, arsenic was present above ATSDR's comparison level for incidental ingestion.

Surface Water: Upstream and Downstream

Seven samples of water taken from Silver Creek upstream of Area B were analyzed; some also were reported from the creek immediately downstream of the site, near US 189, and many more analyses were for creek samples taken at Atkinson, approximately 4 miles downstream. Because water quality varies under different flow rates, the sampling data may not represent conditions over time. Maximum concentrations are shown in Table 10 (Appendix B). For most of the substances, ATSDR's review of the data suggests that maximum concentrations are not substantially greater downstream than upstream.

Upstream, substances that exceeded ATSDR's comparison values for drinking water are antimony, arsenic, beryllium, cadmium, lead, and zinc. Downstream, comparison values were exceeded by antimony, arsenic, beryllium, cadmium, lead, manganese, and zinc.

Sediments: Upstream and Downstream

Upstream of Area B, one sediment sample was taken in Pace Homer Ditch and two from Silver Creek. Downstream, a sample of sediment was taken from the creek several hundred feet from the site. Maximum concentrations of substances are shown in Table 11 (Appendix B).

The arsenic and beryllium in the upstream and downstream sediments exceed ATSDR's comparison values for incidental ingestion; antimony, lead, and zinc levels are also elevated for upstream sediments.

Ambient Air

In 1985, an EPA contractor obtained information that showed wind-driven fugitive dust moving off site. In 1986, ambient air was monitored at one station about 3,000 feet south-southeast of Area A. Because of the short sampling interval, the monitoring data may not be representative of conditions over time. Prevailing wind during the monitoring period was from the west-northwest and south east. Thus, the monitoring location was not in the prevailing downwind direction from the site at any time during the sampling program. Maximum concentrations of substances are shown in Table 12 (Appendix B). Several samples were analyzed for arsenic, cadmium, lead, and zinc. Constituent levels were much less than had been recorded at on-site locations during that study (Table 6). Arsenic was not detected. The concentration of cadmium, although quite low, exceeds ATSDR's comparison value for ambient air. Cadmium levels and the low concentrations of lead and zinc detected appear consistent with values for rural settings. However, had the monitoring station been in the direction of prevailing wind, ATSDR believes that the concentrations 3,000 feet from the site might have been greater. Review of the on-site air monitoring data shows that one of the stations that recorded substantial concentrations was only a few hundred feet inside Area A, thus the concentrations shown in Table 6 may be indicative of the levels in immediate off-site areas at that time.

In 1992, when an estimated 80% of the tailings deposit at Area A was covered with soil or salt grass, ambient air quality monitoring was conducted for two days at five locations along the fence, shown in Figure 2. Because of the short sampling interval, the monitoring data may not be representative of conditions over time. The monitor locations were about 150 to 800 feet from Area A. Those analyses detected only zinc at low concentrations (0.1 $\mu g/m^3$) at three of the monitors. This is less than a tenth of the maximum zinc that had been found in

on-site monitors in 1986. However, none of the monitors were situated downwind for any extended length of time (USEPA 1992c).

C. Quality Assurance and Quality Control

Only some of the reference documents contain quality assurance information for investigations, sampling, and laboratory analyses. In preparing this assessment, ATSDR presumed that protocols and results from other agencies are valid. The completeness and reliability of the information could affect the validity of ATSDR's conclusions.

D. Physical and Other Hazards

ATSDR did not observe any physical or other hazards at the site.

PATHWAYS ANALYSES

ATSDR identifies human exposure pathways by examining environmental and human components that might lead to contact with contaminants. A pathway analysis considers five elements: a source of contamination, transport through an environmental medium, a point of exposure, a route of human exposure, and an exposed population. Completed exposure pathways are those for which the five elements are evident and indicate that exposure to a contaminant has occurred in the past, is currently occurring, or will occur in the future. Potential exposure pathways are those for which one or more of the elements is not clearly defined, but could be present. Potential pathways indicate that exposure to a contaminant could have occurred in the past, could be occurring now, or could occur in the future.

ATSDR's preliminary health assessment of 1990 addressed several exposure pathways associated with soil and tailings, groundwater, food-chain, ambient air, and surface water. This addendum evaluates exposure pathways using all available sampling and site-related information.

Pathway analyses conducted for the site area indicate that there are several completed exposure pathways associated with tailings, soil, surface water, air, and groundwater. Affected populations include tailings workers, site trespassers, and possibly some public water system users north of the property. The completed pathway elements are summarized in Table 13 (Appendix B)

Several potential exposure pathways--associated with tailings, soil, surface water, air, groundwater, sediment, and possibly

foods--could also exist. Potentially exposed populations include site and area workers and residents, trespassers, road workers, ranchers, consumers, and fishermen. The potential pathway elements are summarized in Table 14 (Appendix B).

Tables 15 and 16 (Appendix B) further characterize exposed and potentially exposed populations and associated media and contaminants.

A. Completed Exposure Pathways

Tailings and Surface Soil Pathways On Site: Area A

Metals are present in tailings, and, at low concentrations, in the tailing cover soils. Tailings also are likely to have been mixed with surface soil on the perimeter of Area A. During the years tailings were deposited, the workforce is believed to have been exposed to contaminants in tailings and some soils principally through incidental ingestion and inhalation. Trespassers are believed to have been exposed in a similar manner.

Surface Water Pathways On Site: Area A

Water used to transport tailings and surface water runon that ponded in Area A are likely to have contained elevated levels of metals. When tailings were being deposited, workers were likely to have been exposed to contaminants in those waters through incidental ingestion. Trespassers are likely to have been exposed less extensively to water-born contaminants through incidental ingestion.

Ambient Air Pathways On Site: Area A

Air sample data from 1986 confirm that metals have been entrained in ambient air in the past in Area A as a result of wind eroding and suspending particles from the tailings surface. At the time of that sampling activity, most of the tailings area was not covered or vegetated. ATSDR believes that the on-site workforce was exposed to airborne contaminants through inhalation during the years the tailings were being deposited. Trespassers who entered the site before the property was fenced were likely to have been exposed through inhalation.

Public Water Systems Off Site: Downstream Silver Creek Watershed

Three public water systems obtain at least a part of their supply from wells that are within the Silver Creek watershed. Sampling data show metals in these water supplies, but not at extraordinary levels--arsenic, however, is potentially of concern

at even low levels. Water system customers are exposed to low levels of some contaminants--past, present, and future--principally through ingestion and, to a small degree, through aerosol inhalation (showering). It is not certain whether water quality at those wells is actually affected by site releases. The wells are a considerable distance from the site and are on basin slopes, not by the stream. Also, contaminant dilution and adsorption in the subsurface are likely to prevent substantive increases of metals at those wells.

B. Potential Exposure Pathways

Tailings and Surface Soils Pathways On Site: Area A, Area B

Remediation and maintenance workers on site in Area A after tailings disposal stopped are potentially exposed--past, present, and in the future--through ingestion and inhalation to contaminants contained in tailings and possibly to those in the layer of cover soils or in adjacent natural surface soils. Should the area ever be developed for homes or businesses, residents and workers potentially would be exposed, principally through ingestion and inhalation, to contaminants in tailings and soils.

Trespassers might enter the flood plain in Area B infrequently. They potentially are exposed--past, present, and future--through ingestion and inhalation to contaminants in tailings and possibly to contaminants in adjacent surface soils.

Surface Water Pathways On Site: Area A

Surface water that ponds in Area A or flows through the diversion ditch to the marsh and into Silver Creek contains contaminants to which remediation and maintenance workers potentially are exposed--past, present, and future--principally through incidental ingestion.

Ambient Air Pathways On Site: Area A

On-site remediation and maintenance workers are potentially exposed through inhalation--past, present, and future--to contaminants entrained by wind or by vehicle and heavy equipment activity.

Groundwater Pathways Off Site

Residential Wells

The three to four residences within a mile of the site are southwest of the site and close to Silver Creek. The private

wells that service those residences appear to be hydraulically upgradient from the RFT site and are not likely to be affected by site releases to groundwater. Groundwater at those wells is more likely to be affected by contaminants released from tailings deposits at Prospector Square or Silver Maple Claims. Data are not available to confirm water quality at those private wells. Therefore, ATSDR conservatively presumes that those well users potentially are exposed--past, present, and future--principally through ingestion and possibly through aerosol inhalation (showering) to contaminants that might originate from tailings near Park City.

Business/Industrial Wells

Three businesses northwest of the site get their industrial water supply from wells that are hydraulically downgradient from the site. Arsenic and lead were present in one or more of the wells at low levels--levels that were about the same or less than the concentrations found in a background well south of the site. Thus, it is uncertain whether any of the contaminants originated from site releases. Concentrations might increase if contaminated groundwater enters the water supply aquifer in substantive quantity in the future. However, dilution and adsorption in the groundwater regime are likely to prevent substantive contaminant increases in those wells. Workers using the industrial water potentially are exposed to contaminants in groundwater--past, present, and future--through incidental ingestion and aerosol inhalation.

Surface Soils Pathways Off Site

Wind has likely deposited tailings contaminants on surface soils in the vicinity of the site. Some surface soils on the creek flood plain also might contain elevated levels of contaminants as a result of tailings deposition. Workers who constructed US-40 possibly were exposed through incidental ingestion and inhalation to contaminants in surface soils in the vicinity. Also, nearby residents, employees, and road maintenance persons potentially are exposed--past, present, and future--through similar routes.

Creek Surface Water Pathways Off Site

Runoff from on-site tailings and releases into Silver Creek upstream of the site resulted in contamination (dissolved and particles) of creek water. County flood control maintenance workers and ranchers who draw water from the creek potentially are exposed--past, present, and future--through incidental ingestion to contaminants in creek water.

Creek Sediments Pathways Off Site

Creek sediments in the site vicinity contain contaminated sediment particles, including tailings particles, that have been transported from the site or from locations upstream of the site. County flood control maintenance workers and possibly ranchers who draw water from the creek potentially are exposed--past, present, and future--through incidental ingestion to contaminated creek sediments.

Ambient Air Pathways Off Site

In the past, wind was observed to suspend and transport tailings and contaminated surface soils from on-site areas. Strong winds also are likely to suspend and transport flood plain tailings during dry weather. Winds also are likely to resuspend contaminated particles from areas off site where they had been deposited previously by wind. Results of air sampling at the fence in 1992 suggest that levels of site-related wind-borne contamination may be inconsequential when cover soils are in place, providing cover and salt grass are maintained. However, data may not be representative of conditions over time.

The lateral extent of contaminant transport by wind or contaminant deposition is not known. The general prevailing wind direction is reported to be northwest; a several-day air quality study recorded winds toward the northwest and southeast (E&E 1985). For these dominant wind directions, the populations that would most likely be exposed through inhalation--past, present, and future--are the employees of three companies located a short distance northwest of the site. Other potential exposed populations include residents of the three homes that are southwest of the site. Motorists, bikers, and maintenance workers on the roads adjacent to the site are potentially exposed for short periods. Workers who recently constructed the new segment of US-40 adjacent to the site may have been exposed as well.

Food Chain Pathways Off Site

Food Products--Cattle, Sheep, Milk, Grain

ATSDR is not aware of any sampling data for edible products grown in the site vicinity. Results of research and sampling elsewhere suggest that bioaccumulation of some metals may occur in agricultural products. This may include meat or milk from stock that drink contaminated water, from stock that graze on vegetation on which wind-blown contaminants have deposited or on vegetation grown in contaminated soil or irrigated with contaminated water from Silver Creek, or from stock that drink

contaminated surface water. Some contaminants might also concentrate in grain. Therefore, persons who consume food products associated with cattle, sheep, or grain raised in the site vicinity potentially are exposed--past, present, and future--to contaminants taken up from environmental media. Appreciable exposure from this potential source is unlikely for people who obtain that food through mass distribution channels, but is plausible for repeat users of that food, such as the local ranchers and their families.

Fish in Silver Creek

Cutthroat trout have been reported in Silver Creek; although, from ATSDR's observations of the stream, trout populations might not appear viable year-around except far downstream toward Wanship, which is about 10 miles from the site. EPA reported seeing a pan-sized trout within the site boundary in the Spring of 1992 (USEPA 1993). Trout may concentrate some metals from surface water and from its foodchain. Therefore, persons who consume trout or other game fish from Silver Creek potentially are exposed--past, present, and future,--to site-related contaminants. No sampling data are available to confirm whether fish contain contaminants.

PUBLIC HEALTH IMPLICATIONS

A. Toxicologic Evaluation

ATSDR staff evaluated all completed and potential exposure pathways in the following sections for toxicologic effects related to exposure.

Completed Exposure Pathways

To determine whether adverse health effects could result from exposure, ATSDR staff used contamination level data from each completed pathway to estimate exposure doses for each contaminant of concern. Doses were then compared to a Minimal Risk Level (MRL) or a Reference Dose (RfD). The MRL is developed by ATSDR; the RfD is developed by EPA. Both represent an estimate of daily exposure to a contaminant below which non-cancer adverse health effects are unlikely to occur. If an exposure dose has exceeded an MRL or RfD, the estimated exposure dose can then be compared to experimental data from human or animal studies to determine which effects may be of concern. When a contaminant is capable of causing cancer (carcinogenic), staff also considered the estimated exposure dose to calculate whether an increase in the cancer rate is expected.

Tailings and Surface Soil Pathways On Site; Area A

ATSDR staff assumed workers were in the most heavily contaminated areas at most 60 days per year, and incidently consumed 100 mg tailings (or soil) per day. ATSDR staff then compared the estimated ingestion exposure doses with doses received by people in epidemiologic studies or received by animals in laboratory studies and evaluated whether adverse health effects are possible. Estimated exposure doses were below levels of health concern for all contaminants in soil and tailings; therefore, adverse health effects are unlikely to have occurred in workers. Given the relative infrequency of people wandering on the site before construction of the fence, adverse health effects are unlikely for trespassers.

Surface Water Pathways On Site; Area A

People who worked when tailings were being deposited may have been exposed to contaminants principally via incidental ingestion of surface water. ATSDR staff estimated exposure doses to contaminants in surface water on the site; those doses are all significantly below levels of public health concern. ATSDR staff expect no adverse health effects in workers as a result of exposure to contaminated surface water. Given the relative infrequency of people wandering onto the site before the fence was constructed, adverse health effects are unlikely for trespassers.

Ambient Air Pathways on Site; Area A

People who worked on site without respirators before the site was substantially covered with soil and vegetation were exposed to contaminants in the air. Ambient on-site air concentrations were evaluated for adverse health effects of inhalation. Concentrations measured in air presented no public health hazard.

Public Water Systems Off Site; Downstream in Silver Creek Watershed

Long-term users of the High Valley Water Company and Summit County Service Area #3 public water supplies may have been exposed via ingestion to arsenic, but that exposure probably did not last a sufficient time to pose a public health hazard. Arsenic in the public water supply may not be site related.

Although other metals are present in the public drinking water supplies, none are at levels that may be considered harmful to the general public. Sodium is at a level that people on a sodium-restricted diet should avoid.

Potential Exposure Pathways

To determine whether adverse health effects could result from exposure, ATSDR staff used contamination level data when available from each potential pathway to estimate exposure doses for each contaminant of concern. These doses were then compared to MRLs or RfDs, as discussed above. When data were not available, staff made assumptions to enable analysis of pathways. These assumptions, when used, are stated below.

Tailings and Surface Soils Pathways On Site; Area A, Area B

ATSDR staff estimated ingestion exposure doses for workers and evaluated whether adverse health effects are possible. Estimated exposure doses were below levels of health concern for all contaminants in tailings in area B; therefore, adverse health effects are unlikely for workers. ATSDR staff do not have data regarding levels of contaminants in soils because tailings disposal ended; we also do not have information on contaminants in cover soil or adjacent natural surface soils. However, levels are not expected to be significantly higher, and could be considerably lower, than those measured in tailings on the site. Estimated exposure doses, therefore, would be lower than those estimated above in the COMPLETED EXPOSURE PATHWAYS section. Adverse health effects to workers are not expected from exposure via these potential pathways.

Should the property be developed, at a future time, for residential purposes, people would receive an exposure dose corresponding to typical residential exposures (365 days a year). ATSDR staff estimated potential ingestion exposure doses for individuals who would live on the site at a future time. In that case, people would receive exposure doses of arsenic, beryllium, cadmium and lead at levels of health concern. Elevated levels of contaminants make the site unsuitable for residential or gardening purposes.

Surface Water Pathways On Site; Area A

It is not known whether people who have worked on the site since tailings disposal ceased have come in contact with surface water. Because the completed surface water pathway previously discussed was evaluated to be of no public health concern, adverse health effects are not expected from exposure via this potential pathway.

Ambient Air Pathways On Site; Area A

The completed ambient air pathway previously discussed was evaluated to be of no public health concern. Therefore, adverse

health effects are not expected from exposure via this potential pathway.

Groundwater Pathways Off Site

Residential Wells

ATSDR staff have no information about contaminant levels in residential wells southwest of the site. However, since those wells are hydraulically upgradient from the site, it is unlikely that people are being exposed to site-related contaminants at levels of public health concern. This document does not consider contributions from Prospector Square.

Business/Industrial Wells

Workers are potentially exposed to contaminants through incidental ingestion and possibly aerosol inhalation. Exposures associated with those potential pathways are low enough to be considered of no public health concern.

Surface Soil Pathways Off Site

Nearby residents, employees, and road maintenance people are potentially exposed to contaminants through incidental ingestion. ATSDR staff estimated exposure doses associated with off-site surface soil. Those doses are low enough to be considered of no public health concern, primarily due to the infrequency of exposure.

Should that area be developed, at some future time, for residential purposes, those residents would receive a larger incidental ingestion exposure dose than would the occasional visitor or worker. ATSDR staff estimated potential ingestion exposure doses for individuals who would live near the site at some future time. In that case, individuals would receive exposure doses of arsenic, beryllium, and lead at levels of health concern.

Elevated levels of contaminants make the area near the site unsuitable for residential or gardening purposes.

Creek Surface Water Pathways Off Site

County maintenance workers and ranchers are potentially exposed to contaminants through incidental ingestion of creek water. Exposures associated with that potential pathway are low enough to be considered of no public health concern.

Creek Sediments Pathway Off Site

County maintenance workers and ranchers are potentially exposed to contaminants through incidental ingestion of creek sediments. Exposures associated with that potential pathway are significantly low enough to be considered of no public health concern.

Ambient Air Pathways Off Site

People who work or live near the site are potentially exposed to contaminants in the air. Off-site ambient air concentrations were evaluated for adverse health effects of inhalation. Concentrations measured in air do not represent a public health hazard.

Food Chain Pathways Off Site

ATSDR staff have no information about contaminant levels in cattle, sheep, milk, grains, or fish on or near the site. It is not likely that those sources of food are contaminated with site-related contaminants at a level of public health concern.

B. Health Outcome Data Evaluation

The lead at this site is bound up in tailings similar to the tailings found at Prospector Square. ATSDR studies at Prospector Square indicate that exposure to these tailings did not result in any increase in blood lead, arsenic, or cadmium levels, as compared to local controls (ATSDR 1988). No further health studies were recommended. Because the frequency and duration of exposure to tailings in the residential Prospector Square area are expected to be significantly higher than the frequency and duration of exposure to tailings at Richardson Flats, it is likely that exposure to lead at Richardson Flats will not result in an increase in blood lead levels.

Although it is not known exactly how many people have been exposed to contaminants at the site, ATSDR staff estimate that only a few people were exposed. Furthermore, the exposure level is not of public health concern. Finally, the exposure has ended. For those reasons, ATSDR staff believe it is unlikely that anyone who was exposed will develop any adverse health effects from that exposure. In addition, ATSDR staff are unaware of any recent community health concerns of the residents. Therefore, ATSDR staff did not examine health outcome data. If new information becomes available, or if nearby residents have health concerns about contaminants associated with the site, ATSDR will reconsider evaluating health outcome data.

C. Community Health Concerns Evaluation

Because there is no information about levels of contaminants in blowing dust, ATSDR staff cannot evaluate the health hazard posed by inhalation of the dust. ATSDR staff evaluated available ambient air data (see Toxicologic Evaluation section). Levels of contaminants in blowing dust generated from topsoil should not pose a public health hazard. When the tailings are completely covered by topsoil or when vegetation has adequately anchored the soil, there should not be any contaminated dust or other contaminated particulates blowing off site in concentrations above comparison values. ATSDR staff are not aware of any other community health concerns.

CONCLUSIONS

1. ATSDR considers the RFT site to be no apparent public health hazard in the past or present. Evaluations of available information for completed exposure pathways suggest that associated doses are at levels of no apparent health concern. That is, doses are not high enough to result in adverse health effects in people near the site or in persons who have worked on site. ATSDR staff do not expect contaminant levels or exposure doses associated with potential pathways to be high enough to result in adverse health effects in people near the site or people who worked on the site. However, should the site, or areas near the site where significant levels of contaminants may be found, be developed for residential purposes, contaminant levels would be at levels of health concern. For this reason, ATSDR considers the RFT site an indeterminant public health hazard in the future.

2. The only community concern expressed was about wind-blown dust. Exposure to such dust does not appear to be a public health hazard.

3. The owners report they will not develop the property; that commitment may avoid potentially adverse exposures that would result from daily exposure to some of the on-site contaminants in the future. However, that commitment is not enforceable.

4. Should additional data become available that indicate people are being exposed to contaminants at levels of public health concern, the first conclusion will be revised.

RECOMMENDATIONS

Cease/Reduce Exposure Recommendations

1. Finish placing soil cover over tailings in a timely manner.

2. Conduct periodic maintenance in tailings area to cover soil and vegetation.

3. See that on-site workers are well trained and use adequate protective equipment.

4. If urban development extends substantively closer to the site, consider measures to reduce potential for public exposure.

5. If evidence arises in the future that confirms tailings were taken off site and confirms their specific location(s), consider evaluating related exposure, public health, and remedial issues.

6. Local governments should be encouraged to impose appropriate land-use restrictions at the site and areas upstream and downstream that might be impacted by tailings. Those restrictions should be intended to limit uses of affected areas that could result in exposures posing an unacceptable health risk.

Site/Area Characterization Recommendations

1. Conduct a private well survey within 1 mile (upgradient and downgradient); analyze groundwater samples taken from wells. If water quality is not consistent with public health criteria, alternate water supplies should be obtained and the well survey and sampling should be appropriately expanded. In addition, ATSDR's conclusion regarding the public health hazard associated with this site would have to be reevaluated.

2. Review nearby public water systems information periodically for evidence of the groundwater supply being impacted.

3. If urban development extends substantially closer to the site, sample surface soils more extensively off site. As a part of this effort, consider whether tailings deposited on site might have flowed beyond the present containment area, for example to low-lying areas on the south side of County Road.

Health Activities Recommendation Panel (HARP) Recommendations

In accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, data and information developed in the Amendment to the Public Health Assessment for the Richardson Flats Tailings site in Summit County, Utah, have been evaluated for appropriate followup with respect to health activities. Available information indicates that no human exposure to contaminants at levels of public health concern is occurring or has occurred. In addition, the community has not expressed health concerns. For these reasons, ATSDR has concluded that no follow-up actions should be pursued at this time. If more information becomes available indicating that human exposure to hazardous substances is occurring or has occurred in the past at levels of public health concern, ATSDR will reevaluate this site for any additional indicated followup.

Public Health Actions

The purpose of the Public Health Action Plan (PHAP) is to ensure that this public health addendum not only identifies public health hazards but also provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment.

Based on discussions with EPA Region VIII, EPA will consider the Cease/Reduce Exposure and Site/Area Characterization recommendations listed above when they develop the work plan for this site. Based on the HARP determination that no health follow-up activities are required by ATSDR, no PHAP for health follow-up activities has been developed for this public comment release.

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RICHARDSON FLATS TAILINGS PRELIM. PHA ADD. PUBLIC COMMENT RELEASE

APPENDIX A

SITE MAPS

Figure 1
Location Plan

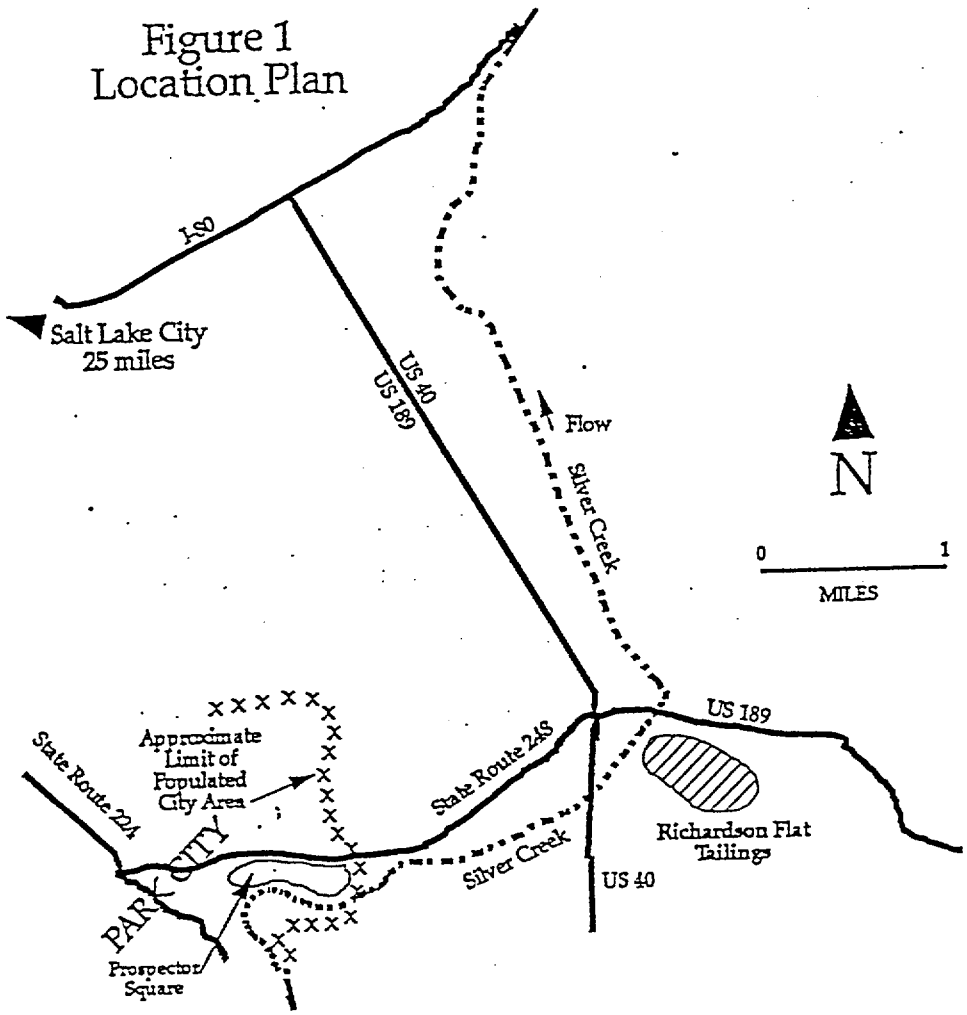
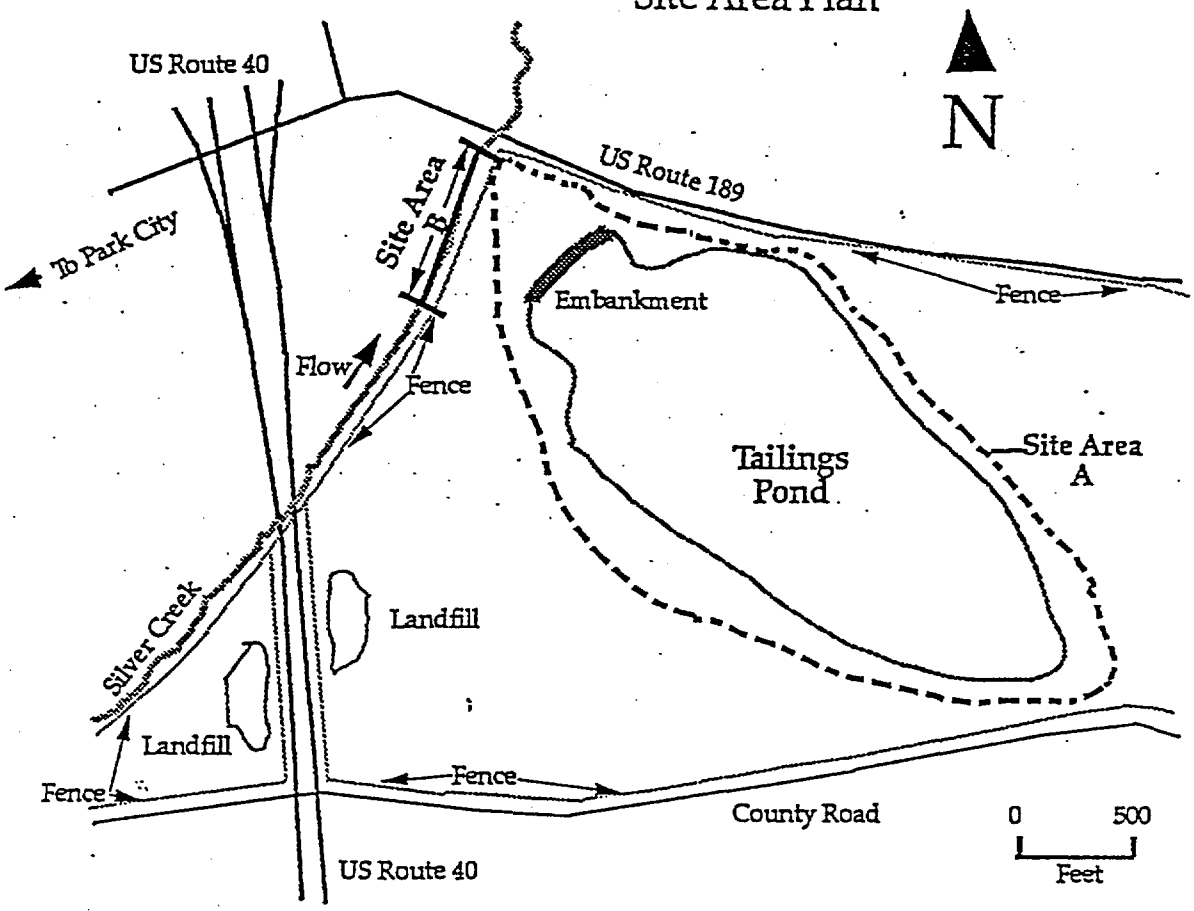


Figure 2
Site Area Plan



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APPENDIX B

CONTAMINANT AND PATHWAY TABLES

TABLE 1 Contaminant Concentrations in Groundwater On Site; Area A--Monitoring Wells

Contaminant	Maximum Concentration (ppb)	(reference)	Date	Comparison Value (ppb)	Source
Aluminum	94,900*	E&E 1993	1992	none	
Antimony	35.9?	E&E 1992	1992	4	RMEG
Arsenic	81.1*	E&E 1993	1992	0.02	CREG
Barium	1,180*	E&E 1993	1992	700	RMEG
Beryllium	4.6J*	E&E 1993	1992	0.0081	CREG
Cadmium	48	E&E 1985	1985	2	EMEG
Calcium	365,000	E&E 1992	1992	none	
Chromium	110J*	E&E 1993	1992	10,000	RMEG
Cobalt	80	E&E 1985	1985	none	
Copper	1,583	E&E 1985	1985	1,300	AL
Iron	130,000	E&E 1985	1985	none	
Lead	1,080	E&E 1985	1985	15	AL
Magnesium	88,000	E&E 1985	1985	none	
Manganese	22,300*	E&E 1993	1992	1,000	RMEG
Mercury	0.7	E&E 1985	1985	2	LTHA
Nickel	93.1*	E&E 1993	1992	100	LTHA
Potassium	22,100*	E&E 1993	1992	none	
Silver	17	E&E 1985	1985	50	RMEG
Sodium	54,000	E&E 1985	1985	none	
Thallium	<100	E&E 1985	1985	0.4	LTHA
Vanadium	266	E&E 1985	1985	20	LTHA
	Table 1 Continues				

Contaminant	Maximum Concentration (ppb)	(reference)	Date	Comparison Value (ppb)	Source
Zinc	2,790	E&E 1985	1985	2,100	LTHA

*- Sample obtained by landfill
Unfiltered sample data
ppb-parts per billion
?- approximate value
<- less than
AL- action level
J- estimated value
CREG- cancer risk evaluation guide
RMEG- reference dose media evaluation guide
LTHA- lifetime health advisory
EMEG- environmental media evaluation guide

TABLE 2 Contaminant Concentrations in Tailings On Site; Areas A and B

Contaminant	Maximum Concentration (ppm)	(reference)	Date	Comparison Value (ppm)	Source
Aluminum	A-3,440 B-1,030	E&E 1985 E&E 1989	1985 1989	none	
Antimony	A-171 B-144	E&E 1985 E&E 1989	1985 1989	280	RMEG
Arsenic	A-3,600 B-259*	E&E 1985 E&E 1989	1985 1989	0.4	CREG
Barium	A-153 B-117	E&E 1989 E&E 1989	1989 1989	49,000	RMEG
Beryllium	A-1.2 B-ND	E&E 1992 E&E 1989	1992 1989	0.16	CREG
Cadmium	A-169 B-250	E&E 1985 E&E 1989	1985 1989	140	EMEG
Calcium	A-117,000 B-32,800	E&E 1985 E&E 1989	1985 1989	none	
Chromium	A-60 B-ND	E&E 1985 E&E 1989	1985 1989	700,000	RMEG
Cobalt	A-12.6 B-3.9*	E&E 1992 E&E 1989	1992 1989	none	
Copper	A-961 B-281	E&E 1985 E&E 1989	1985 1989	none	
Iron	A-154,000 B-87,000	E&E 1985 E&E 1989	1985 1989	none	
Lead	A-8,530 B-31,600	E&E 1985 E&E 1989	1985 1989	none	
Magnesium	A-23,000 B-1,140*	E&E 1989 E&E 1989	1989 1989	none	
Manganese	A-5,990 B-252	E&E 1985 E&E 1989	1985 1989	70,000	RMEG
	Table 2 continues				

Contaminant	Maximum Concentration (ppm)	(reference)	Date	Comparison Value (ppm)	Source
Mercury	A-3.6? B-8.2	E&E 1992 E&E 1989	1992 1989	none	
Nickel	A-9.4 B-6.2*	E&E 1989 E&E 1989	1989 1989	none	
Potassium	A-917 B-1,140*	E&E 1992 E&E 1989	1992 1989	none	
Silver	A-26 B-115	E&E 1985 E&E 1989	1985 1989	3,500	RMEG
Sodium	A-11,300 B-603*	E&E 1985 E&E 1989	1985 1989	none	
Thallium	A-41.7 B-9.7*	E&E 1992 E&E 1989	1992 1989	none	
Vanadium	A-13.0 B-2.6	E&E 1992 E&E 1989	1992 1989	none	
Zinc	A-23,200 B-33,800	E&E 1985 E&E 1989	1985 1989	none	

A- Area A B- Area B
ppm- parts per million CREG- cancer risk evaluation guide
?- approximate value RMEG- reference dose media evaluation guide
*- estimated value EMEG- environmental media evaluation guide

TABLE 3 Contaminant Concentrations in Soil Cover Layer Over Tailings On Site; Area A

Contaminant	Maximum Concentration (ppm)	(reference)	Date	Comparison Value (ppm)	Source
Aluminum	25,300	E&E 1992	1992	none	
Antimony	5.7?	E&E 1992	1992	280	RMEG
Arsenic	20.9?	E&E 1992	1992	0.4	CREG
Barium	317	E&E 1992	1992	49,000	RMEG
Beryllium	1.2	E&E 1992	1992	0.16	CREG
Cadmium	5.0?	E&E 1992	1992	140	EMEG
Calcium	9,480	E&E 1992	1992	none	
Chromium	28.2	E&E 1992	1992	700,000	RMEG
Cobalt	15.0	E&E 1992	1992	none	
Copper	50.4	E&E 1992	1992	none	
Iron	2,750	E&E 1992	1992	none	
Lead	223	E&E 1992	1992	none	
Magnesium	5,570	E&E 1992	1992	none	
Manganese	1,030	E&E 1992	1992	70,000	RMEG
Mercury	0.16	E&E 1992	1992	none	
Nickel	21.6	E&E 1992	1992	none	
Potassium	5,650	E&E 1992	1992	none	
Silver	4.1?	E&E 1992	1992	3,500	RMEG
Sodium	319?	E&E 1992	1992	none	
Thallium	1.9?	E&E 1992	1992	none	
Vanadium	57.4	E&E 1992	1992	none	
Zinc	432	E&E 1992	1992	none	

ppm- parts per million
?- approximate value
CREG- cancer risk evaluation guide
RMEG- reference dose media evaluation guide
EMEG- environmental media evaluation guide

TABLE 4 Contaminant Concentrations in Surface Water On Site; Area A (Diversion Ditch and Marsh) and Area B (Silver Creek)

Contaminant	Maximum Concentration (ppb)	(reference)	Date	Comparison Value (ppb)	Source
Aluminum	A-30,900 B-77	E&E 1989 E&E 1985	1989 1985	none	
Antimony	A-937 B-39	E&E 1989 E&E 1992	1989 1992	4	RMEG
Arsenic	A-2,326 B-619	E&E 1989 E&E 1989	1989 1989	0.02	CREG
Barium	A-2,330 B-60.8*	E&E 1989 E&E 1989	1989 1989	700	RMEG
Beryllium	A-3.2? B-2.4*	E&E 1992 E&E 1989	1992 1989	0.0081	CREG
Cadmium	A-289 B-35?	E&E 1989 E&E 1992	1989 1992	2	EMEG
Calcium	A-446,000 B-149,000	E&E 1989 E&E 1992	1989 1992	none	
Chromium	A-50.2 B-72.2	E&E 1989 E&E 1989	1989 1989	10,000	RMEG
Cobalt	A-48.7* B-5.7*	E&E 1989 E&E 1989	1989 1989	none	
Copper	A-1,540 B-9	E&E 1989 E&E 1985	1989 1985	1,300	AL
Iron	A-107,000 B-389	E&E 1989 E&E 1985	1989 1985	none	
Lead	A-22,100* B-15?	E&E 1989 E&E 1992	1989 1992	15	AL
Magnesium	A-104,000 B-33,600	E&E 1989 E&E 1992	1989 1992	none	
	Table 4 continues				

Contaminant	Maximum Concentration (ppb)	(reference)	Date	Comparison Value (ppb)	Source
Manganese	A-21,100 B-434	E&E 1989 E&E 1985	1989 1985	1,000	RMEG
Mercury	A-8 B-11.5	E&E 1989 E&E 1989	1989 1989	2	LTHA
Nickel	A-65.5 B-67.3*	E&E 1989 E&E 1989	1989 1989	100	LTHA
Potassium	A-15,600 B-1,950?	E&E 1989 E&E 1992	1989 1992	none	
Silver	A-201 B-117	E&E 1989 E&E 1989	1989 1989	50	RMEG
Sodium	A-58,500 B-42,700	E&E 1989 E&E 1989	1989 1989	none	
Thallium	A-83.4* B-4.2*	E&E 1989 E&E 1989	1989 1989	0.4	LTHA
Vanadium	A-58.7 B-121	E&E 1989 E&E 1989	1989 1989	20	LTHA
Zinc	A-49,100 B-1,650	E&E 1989 E&E 1985	1989 1985	2,100	LTHA

A- Area A B- Area B
ppb- parts per billion CREG- cancer risk evaluation guide
?- approximate value RMEG- reference dose media evaluation guide
*- estimated value LTHA- lifetime health advisory
AL- action level EMEG- environmental media evaluation guide

TABLE 5 Contaminant Concentrations in Sediments On Site; Area A (Diversion Ditch, Marsh, Ponded Water Locations) and Area B (Silver Creek)

Contaminant	Maximum Concentration (ppm)	(reference)	Date	Comparison Value (ppm)	Source
Aluminum	A-28,800 B-8,620	E&E 1992 E&E 1989	1992 1989	none	
Antimony	A-200* B-201*	E&E 1989 E&E 1989	1989 1989	280	RMEG
Arsenic	A-839 B-590	E&E 1989 E&E 1989	1989 1989	0.4	CREG
Barium	A-1,220 B-147	E&E 1989 E&E 1989	1989 1989	49,000	RMEG
Beryllium	A-2.3 B-0.86*	E&E 1992 E&E 1989	1992 1989	0.16	CREG
Cadmium	A-185* B-91.4*	E&E 1989 E&E 1989	1989 1989	140	EMEG
Calcium	A-249,000 B-25,600	E&E 1989 E&E 1989	1989 1989	none	
Chromium	A-62.9? B-1.0*	E&E 1992 E&E 1989	1992 1989	700,000	RMEG
Cobalt	A-64.4 B-43.5	E&E 1989 E&E 1989	1989 1989	none	
Copper	A-870 B-753	E&E 1989 E&E 1989	1989 1989	none	
Iron	A-156,000 B-148,000	E&E 1989 E&E 1989	1989 1989	none	
Lead	A-13,600 B-14,200	E&E 1989 E&E 1989	1989 1989	none	
Magnesium	A-33,800 B-9,430	E&E 1989 E&E 1989	1989 1989	none	
	Table 5 continues				

Contaminant	Maximum Concentration (ppm)	(reference)	Date	Comparison Value (ppm)	Source
Manganese	A-207,000 B-1,730	E&E 1989 E&E 1989	1989 1989	70,000	RMEG
Mercury	A-8.2? B-6.0	E&E 1992 E&E 1989	1992 1989	none	
Nickel	A-97.2 B-28.8	E&E 1992 E&E 1989	1992 1989	none	
Potassium	A-6,270 B-1,160*	E&E 1989 E&E 1989	1989 1989	none	
Silver	A-86.0 B-47.5	E&E 1989 E&E 1989	1989 1989	3,500	RMEG
Sodium	A-1,150? B-181*	E&E 1992 E&E 1989	1992 1989	none	
Thallium	A-24.1* B-4.1*	E&E 1989 E&E 1989	1989 1989	none	
Vanadium	A-70.6 B-21.2	E&E 1992 E&E 1989	1992 1989	none	
Zinc	A-26,400 B-15,500	E&E 1989 E&E 1989	1989 1989	none	

ppm- parts per million
?- approximate value
*- estimated value
A- Area A
B- Area B
RMEG- reference dose media evaluation guide
CREG- cancer risk evaluation guide
EMEG- environmental media evaluation guide

TABLE 6 Contaminant Concentrations in Ambient Air On Site; Area A

Contaminant	Maximum Concentration ($\mu g/m^3$)	(reference)	Date	Comparison Value ($\mu g/m^3$)	Source
Aluminum	NI				
Antimony	NI				
Arsenic	0.0927	E&E 1991c	1986	0.00023	CREG
Barium	NI				
Beryllium	NI				
Cadmium	0.0143*	E&E 1991c	1986	0.00056	CREG
Calcium	NI				
Chromium	NI				
Cobalt	NI				
Copper	NI				
Iron	NI				
Lead	1.6478	E&E 1991c	1986	none	
Magnesium	NI				
Manganese	NI				
Mercury	NI				
Nickel	NI				
Potassium	NI				
Silver	NI				
Sodium	NI				
Thallium	NI				
Vanadium	NI				
Zinc	1.4478*	E&E 1991c	1986	none	

$\mu g/m^3$- micrograms per cubic meter
*- estimated value
NI- no information CREG- cancer risk evaluation guide

TABLE 7 Contaminant Concentrations in Groundwater Off Site; Background Monitoring Well and Three Nearby Industrial Wells

Contaminant	Maximum Concentration (ppb)	(reference)	Date	Comparison Value (ppb)	Source
Aluminum	C-15,700 D-NI	E&E 1992	1992	none	
Antimony	C-<5 D-NI	E&E 1985	1985	4	RMEG
Arsenic	C-3.7? D-4.8?	E&E 1992 E&E 1991d	1992 1991	0.02	CREG
Barium	C-196? D-NI	E&E 1992	1992	700	RMEG
Beryllium	C-1.3? D-NI	E&E 1992	1992	0.0081	CREG
Cadmium	C-<5 D-ND	E&E 1985 E&E 1991d	1985 1991	2	EMEG
Calcium	C-42,000 D-NI	E&E 1992	1992	none	
Chromium	C-10.5 D-ND	E&E 1992 E&E 1991d	1992 1991	10,000	RMEG
Cobalt	C-11? D-NI	E&E 1992	1992	none	
Copper	C-30 D-NI	E&E 1992	1992	1,300	AL
Iron	C-14,000 D-NI	E&E 1992	1992	none	
Lead	C-627? D-36.9	E&E 1992 E&E 1991d	1992 1991	15	AL
Magnesium	C-12,200 D-NI	E&E 1992	1992	none	
	Table 7 continues				

Contaminant	Maximum Concentration (ppb)	(reference)	Date	Comparison Value (ppb)	Source
Manganese	C-162? D-NI	E&E 1992	1992	1,000	RMEG
Mercury	C-<0.1 D-NI	E&E 1985	1985	2	LTHA
Nickel	C-13 D-NI	E&E 1992	1992	100	LTHA
Potassium	C-3,970? D-NI	E&E 1992	1992	none	
Silver	C-<5 D-NI	E&E 1985	1985	50	RMEG
Sodium	C-16,100 D-NI	E&E 1992	1992	none	
Thallium	C-<100 D-NI	E&E 1985	1985	0.4	LTHA
Vanadium	C-<10 D-NI	E&E 1985	1985	20	LTHA
Zinc	C-136? D-NI	E&E 1992	1992	2,100	LTHA

Unfiltered sample data
C- background monitoring well D- three nearby industrial wells
ppb- parts per billion EMEG- environmental media evaluation guide
NI- no information CREG- cancer risk evaluation guide
?- approximate value RMEG- reference dose media evaluation guide
<- less than LTHA- lifetime health advisory
AL- action level

TABLE 8 Contaminant Concentrations in Groundwater Off Site; Public Water Supply Wells--Atkinson Special Improvement District, High Valley Water Company, and Summit County Service Area #3

Contaminant	Maximum Concentration (ppb)	(reference)	Date	Comparison Value (ppb)	Source
Aluminum	E-NI F-NI G-NI			none	
Antimony	E-NI F-NI G-NI			4	RMEG
Arsenic	E-<1 F-7 G-7	UDEQ 1992b UDEQ 1992b UDEQ 1992b	1988 1987 1989	0.02	CREG
Barium	E-60 F-180 G-80	UDEQ 1992b UDEQ 1992b UDEQ 1992b	1988 1987 1989	700	RMEG
Beryllium	E-NI F-NI G-NI			0.0081	CREG
Cadmium	E-<1 F-<1 G-<1	UDEQ 1992b UDEQ 1992b UDEQ 1992b	1988 1987 1988	2	EMEG
Calcium	E-71,000 F-78,000 G-NI	UDEQ 1992b UDEQ 1992b	1988 1987	none	
Chromium	E-<1 F-5 G-<1	UDEQ 1992b UDEQ 1992b UDEQ 1992b	1988 1985 1988	10,000	RMEG
Cobalt	E-NI F-NI G-NI			none	
	Table 8 continues				

Contaminant	Maximum Concentration (ppb)	(reference)	Date	Comparison Value (ppb)	Source
Copper	E-<10 F-120 G-30	UDEQ 1992b UDEQ 1992b UDEQ 1992b	1988 1987 1989	1,300	AL
Iron	E-680 F-710 G-170	UDEQ 1992b UDEQ 1992b UDEQ 1992b	1988 1985 1981	none	
Lead	E-<1 F-<5 G-<1	UDEQ 1992b UDEQ 1992b UDEQ 1992b	1988 1987 1988	15	AL
Magnesium	E-11,000 F-21,000 G-12,000	UDEQ 1992b UDEQ 1992b UDEQ 1992b	1988 1987 1981	none	
Manganese	E-20 F-35 G-25	UDEQ 1992b UDEQ 1992b UDEQ 1992b	1988 1985 1981	1,000	RMEG
Mercury	E-0.2 F-<0.2 G-<0.2	UDEQ 1992b UDEQ 1992b UDEQ 1992b	1988 1987 1989	2	LTHA
Nickel	E-<10 F-NI G-<30	UDEQ 1992b UDEQ 1992b	1988 1989	100	LTHA
Potassium	E-3,000 F-4,000 G-4,000	UDEQ 1992b UDEQ 1992b UDEQ 1992b	1988 1987 1989	none	
Silver	E-<1 F-<2 G-<1	UDEQ 1992b UDEQ 1992b UDEQ 1992b	1988 1987 1989	50	RMEG
Sodium	E-54,000 F-23,000 G-86,000	UDEQ 1992b UDEQ 1992b UDEQ 1992b	1988 1987 1989	none	
Thallium	E-NI F-NI G-NI			0.4	LTHA
	Table 8 continues				

Contaminant	Maximum Concentration (ppb)	(reference)	Date	Comparison Value (ppb)	Source
Vanadium	E-NI F-NI G-NI			20	LTHA
Zinc	E-100 F-150 G-130	UDEQ 1992b UDEQ 1992b	1988 1985 1989	2,100	LTHA

Reference not state whether samples were filtered
E- Atkinson Special Improvement District
F- High Valley Water Company
G- Summit County Service Area #3
ppb- parts per billion
<- less than
NI- no information
AL- action level
CREG- cancer risk evaluation guide
RMEG- reference dose media evaluation guide
LTHA- lifetime health advisory
EMEG- environmental media evaluation guide

TABLE 9 Contaminant Concentrations in Soils Off Site; Surface Soils and Subsurface Soils

Contaminant	Maximum Concentration (ppm)	(reference)	Date	Comparison Value (ppm)	Source
Aluminum	G-14,400 H-16,900	E&E 1985 E&E 1985	1985 1985	none	
Antimony	G-89* H-NAD	E&E 1987a E&E 1985	1987 1985	280	RMEG
Arsenic	G-87 H-6.5	E&E 1987a E&E 1985	1987 1985	0.4	CREG
Barium	G-668 H-147	E&E 1987a E&E 1985	1987 1985	49,000	RMEG
Beryllium	G-43* H-NAD	E&E 1987a E&E 1985	1987 1985	0.16	CREG
Cadmium	G-17 H-7.4	E&E 1985 E&E 1985	1985 1985	140	EMEG
Calcium	G-46,900 H-5,020	E&E 1987a E&E 1985	1987 1985	none	
Chromium	G-743* H-19	E&E 1987a E&E 1985	1987 1985	700,000	RMEG
Cobalt	G-159* H-9.5	E&E 1987a E&E 1985	1987 1985	none	
Copper	G-100 H-17	E&E 1987a E&E 1985	1987 1985	none	
Iron	G-94,200 H-19,700	E&E 1987a E&E 1985	1987 1985	none	
Lead	G-1,100 H-37	E&E 1985 E&E 1985	1985 1985	none	
Magnesium	G-55,000 H-7,620	E&E 1987a E&E 1985	1987 1985	none	
Manganese	G-15,400 H-625	E&E 1987a E&E 1985	1987 1985	70,000	RMEG
	Table 9 continues				

Mercury	G-1.0* H-NAD	E&E 1987a E&E 1985	1987 1985	none	
Nickel	G-52 H-22	E&E 1987a E&E 1985	1987 1985	none	
Potassium	G-1,480* H-NI	E&E 1987a	1987	none	
Silver	G-6.7 H-NAD	E&E 1985 E&E 1985	1985 1985	3,500	RMEG
Sodium	G-5,620 H-279	E&E 1987a E&E 1985	1987 1985	none	
Thallium	G-2.4 H-NAD	E&E 1987a E&E 1985	1987 1985	none	
Vanadium	G-1,390* H-31	E&E 1987a E&E 1985	1987 1985	none	
Zinc	G-1,570 H-70	E&E 1985 E&E 1985	1985 1985	none	

G- surface soils
H- subsurface soils
ppm- parts per million
CREG- cancer risk evaluation guide
*- estimated value
RMEG- reference dose media evaluation guide
EMEG- environmental media evaluation guide

TABLE 10 Contaminant Concentrations in Surface Water Off Site; Upstream (Pace Homer Ditch and Silver Creek) and Downstream (Silver Creek)

Contaminant	Maximum Concentration (ppb)	(reference)	Date	Comparison Value (ppb)	Source
Aluminum	I-172 J-370	E&E 1985 E&E 1985	1985 1985	none	
Antimony	I-36.7? J-35	E&E 1992 E&E 1985	1992 1985	4	RMEG
Arsenic	I-14 J-110	E&E 1985 UDEQ 1992c	1985 1988	0.02	CREG
Barium	I-54.6? J-140	E&E 1992 UDEQ 1992c	1992 1991	700	RMEG
Beryllium	I-3.4? J-2.4?	E&E 1992 E&E 1992	1992 1992	0.0081	CREG
Cadmium	I-3.9? J-10	E&E 1992 UDEQ 1992c	1992 1988	2	EMEG
Calcium	I-23,300 J-163,000	E&E 1992 E&E 1992	1992 1992	none	
Chromium	I-<5 J-8	E&E 1985 UDEQ 1992c	1985 1985	10,000	RMEG
Cobalt	I-<5 J-4.0*	E&E 1985 E&E 1989	1985 1989	none	
Copper	I-12 J-60	E&E 1985 E&E 1985	1985 1985	1,300	AL
Iron	I-725 J-2,290	E&E 1985 E&E 1985	1985 1985	none	
Lead	I-147 J-1,985	E&E 1985 E&E 1985	1985 1985	15	AL
Magnesium	I-38,700 J-37,700	E&E 1992 E&E 1992	1992 1992	none	
	Table 10 continues				

Manganese	I-764 J-1,900	E&E 1985 UDEQ 1992c	1985 1988	1,000	RMEG
Mercury	I-0.2 J-0.3	E&E 1985 UDEQ 1992c	1985 1992	2	LTHA
Nickel	I-25.4? J-NAD	E&E 1992 E&E 1985	1992 1985	100	LTHA
Potassium	I-3,510? J-2,090	E&E 1992 E&E 1989	1992 1989	none	
Silver	I-<5 J-10	E&E 1985 E&E 1992	1985 1992	50	RMEG
Sodium	I-63,600 J-27,600	E&E 1992 E&E 1992	1992 1992	none	
Thallium	I-<100 J-NAD	E&E 1985 E&E 1985	1985 1985	0.4	LTHA
Vanadium	I-<10 J-NAD	E&E 1985 E&E 1985	1985 1985	20	LTHA
Zinc	I-2,690 J-3,700	E&E 1985 UDEQ 1992c	1985 1988	2,100	LTHA

I- upstream of site
J- downstream of site
ppb- parts per billion
AL- action level
*- estimated value
CREG- cancer risk evaluation guide
?- approximate value
RMEG- reference dose media evaluation guide
<- less than
LTHA- lifetime health advisory
NAD- no applicable data
EMEG- environmental media evaluation guide

TABLE 11 Contaminant Concentrations in Sediments Off Site; Upstream (Silver Creek and Pace Homer Ditch) and Downstream of Site (Silver Creek)

Contaminant	Maximum Concentration (ppm)	(reference)	Date	Comparison Value (ppm)	Source
Aluminum	K-18,400* L-20,200	E&E 1989 E&E 1989	1989 1989	none	
Antimony	K-183* L-ND	E&E 1989 E&E 1989	1989 1989	280	RMEG
Arsenic	K-555 L-5.4	E&E 1989 E&E 1989	1989 1989	0.4	CREG
Barium	K-270 L-408	E&E 1989 E&E 1989	1989 1989	49,000	RMEG
Beryllium	K-1.7 L-1.6	E&E 1989 E&E 1989	1989 1989	0.16	CREG
Cadmium	K-113* L-2.2*	E&E 1989 E&E 1989	1989 1989	140	EMEG
Calcium	K-18,900 L-9,640	E&E 1989 E&E 1989	1989 1989	none	
Chromium	K-21.9 L-18.5	E&E 1989 E&E 1989	1989 1989	700,000	RMEG
Cobalt	K-76.8 L-10.9*	E&E 1989 E&E 1989	1989 1989	none	
Copper	K-496 L-40.7	E&E 1989 E&E 1989	1989 1989	none	
Iron	K-263,000 L-25,500	E&E 1989 E&E 1989	1989 1989	none	
Lead	K-12,200 L-108	E&E 1989 E&E 1989	1989 1989	none	
Magnesium	K-6,340 L-6,360	E&E 1989 E&E 1989	1989 1989	none	
	Table 11 continues				

Manganese	K-1,560 L-303	E&E 1989 E&E 1989	1989 1989	70,000	RMEG
Mercury	K-3.3 L-0.1*	E&E 1989 E&E 1989	1989 1989	none	
Nickel	K-31.4 L-17.0	E&E 1989 E&E 1989	1989 1989	none	
Potassium	K-3,160 L-6,050	E&E 1989 E&E 1989	1989 1989	none	
Silver	K-39.8 L-ND	E&E 1989 E&E 1989	1989 1989	3,500	RMEG
Sodium	K-239* L-389*	E&E 1989 E&E 1989	1989 1989	none	
Thallium	K-6.0* L-ND	E&E 1989 E&E 1989	1989 1989	none	
Vanadium	K-48.7 L-37.7	E&E 1989 E&E 1989	1989 1989	none	
Zinc	K-17,500 L-302	E&E 1989 E&E 1989	1989 1989	none	

K- upstream L- downstream
ppm- parts per million CREG- cancer risk evaluation guide
*- estimated value RMEG- reference dose media evaluation guide
EMEG- environmental media evaluation guide

TABLE 12 Contaminant Concentrations in Ambient Air Off Site

Contaminant	Maximum Concentration ($\mu g/m^3$)	(reference)	Date	Comparison Value ($\mu g/m^3$)	Source
Aluminum	NI				
Antimony	NI				
Arsenic	ND ND	E&E 1991c USEPA 1992c	1986 1992	0.00023	CREG
Barium	NI				
Beryllium	NI				
Cadmium	0.0009* ND	E&E 1991c USEPA 1992c	1986 1992	0.00056	CREG
Calcium	NI				
Chromium	NI				
Cobalt	NI				
Copper	NI				
Iron	NI				
Lead	0.0391 ND	E&E 1991c USEPA 1992c	1986 1992	none	
Magnesium	NI				
Manganese	NI				
Mercury	NI				
Nickel	NI				
Potassium	NI				
Silver	NI				
Sodium	NI				
Thallium	NI				
Vanadium	NI				
	Table 12 continues				

Zinc	0.0579* 0.1	E&E 1991c USEPA 1992c	1986 1992	none	
$\mu g/m^3$- micro grams per cubic meter *- estimated value ND- not detected NI- no information CREG- cancer risk evaluation guide					

TABLE 13 COMPLETED EXPOSURE PATHWAYS

COMPLETED PATHWAY NAME	COMPLETED EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	MEDIUM	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	
Tailings On Site Area A	Tailings	Tailings	On Site (Area A)	Ingestion Inhalation, particulates	Tailings workers, Trespassers	Past
Surface Soil On Site Area A	Tailings	Soil	On Site (Area A)	Ingestion Inhalation, particulates	Tailings workers, Trespassers	Past
Surface water On Site Area A	Tailings transport water & runon	Surface water	On Site (Area A)	Ingestion	Tailings workers, Trespassers	Past
Ambient air On Site Area A	Tailings	Air	On Site (Area A)	Inhalation, particulates	Tailings workers, Trespassers	Past
Public water systems	Uncertain	Groundwater	Off Site	Ingestion, inhalation	Residents, Workers (water system users)	Past Present Future

TABLE 14 POTENTIAL EXPOSURE PATHWAYS

POTENTIAL PATHWAY NAME	POTENTIAL EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	MEDIUM	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	
Tailings On Site Area A & Area B	Tailings	Tailings	On Site Area A, Area B	Ingestion Inhalation, particulates	Area A: remediation/ maintenance workers; future residents & workers. Area B: trespassers	Past Present Future
Surface Soil On Site Area A & Area B	Tailings	Soil	On Site Area A, Area B	Ingestion Inhalation, particulates	Remediation/ maintenance workers	Past Present Future
Surface Water On Site Area A	Runon	Surface water	On Site Area A	Ingestion	Remediation/ maintenance workers	Past Present Future
Ambient Air On Site Area A	Tailings	Air	On Site Area A	Inhalation, particulates	Remediation/ maintenance workers	Past Present Future
Table 14 Continues						

POTENTIAL PATHWAY NAME	POTENTIAL EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	MEDIUM	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	
Private well water Off Site	Uncertain	Groundwater	Off Site, closest residences, businesses	Ingestion Inhalation, aerosols	Residents, workers	Past Present Future
Surface soil Off Site	Tailings	Soil (tailings deposition by wind, Silver Creek)	Off Site, site vicinity	Ingestion Inhalation, particulates	US-40 constructors	Past
Surface Soil	Tailings	Soil (tailings deposition by wind, Silver Creek)	Off Site, site vicinity	Ingestion Inhalation, particulates	Road maintenance workers, Nearest residents & employees	Past Present Future
Creek surface water Off Site	Site runoff, upstream discharge to creek.	Water	Off Site, Silver Creek	Ingestion	Maintenance workers, ranchers	Past Present Future
Table 14 Continues						

POTENTIAL PATHWAY NAME	POTENTIAL EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	MEDIUM	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	
Creek sediment Off Site	Tailings	Sediment & tailings	Off Site, downstream	Ingestion	Maintenance workers, ranchers	Past Present Future
Ambient air Off Site	Tailings	Air	Off Site, site vicinity	Inhalation, particulates	Adjacent highway users & maintenance workers, Nearest residents & employees, Nearby recreational users.	Past Present Future
Ambient air Off Site	Tailings	Air	Off Site, site vicinity	Inhalation, particulates	US-40 constructors	Past
Table 14 Continues						

POTENTIAL PATHWAY NAME	POTENTIAL EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	MEDIUM	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	
Food chain Off Site	Water & forage intake	Food products (cattle, sheep, milk, grain)	Off Site	Ingestion foodstuff	Consumers	Past Present Future
Food chain Off Site	Tailings deposit, other upstream sources	Fish	Off Site Residences	Ingestion	Fishermen & families	Past Present Future

TABLE 15 ESTIMATED POPULATION FOR COMPLETED EXPOSURE PATHWAYS

Estimated Exposed Populations		Contaminants and Media:		
Location	**Number**	**aluminum**	**antimony**	**arsenic**
Tailings workers	unknown	surface water, tailings, soil	surface water, tailings, soil	air, soil, surface water, tailings
Site trespassers	unknown	tailings, soil	tailings, soil	tailings, soil, air
Public water supply users; Atkinson well water	248			groundwater?
Public water supply users; High Valley well water	250			groundwater
Public water supply users; Summit Co. #3 well water	75			groundwater

?- indicates uncertainty whether contaminant is present in medium and pathway
Sheet 1 of 8

TABLE 15 ESTIMATED POPULATION FOR COMPLETED EXPOSURE PATHWAYS

Estimated Exposed Populations		Contaminants and Media:		
Location	**Number**	**barium**	**beryllium**	**cadmium**
Tailings workers	unknown	surface water, tailings, soil	surface water, tailings, soil	surface water, tailings, soil, air
Site trespassers	unknown	tailings, soil	tailings, soil	tailings, air, soil
Public water supply users; Atkinson well water	248	groundwater		groundwater?
Public water supply users; High Valley well water	250	groundwater		groundwater?
Public water supply users; Summit Co. #3 well water	75	groundwater		groundwater?

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TABLE 15 ESTIMATED POPULATION FOR COMPLETED EXPOSURE PATHWAYS

Estimated Exposed Populations		Contaminants and Media:		
Location	**Number**	**calcium**	**chromium**	**cobalt**
Tailings workers	unknown	surface water, tailings, soil	surface water, tailings, soil	surface water, tailings, soil
Site trespassers	unknown	tailings, soil	tailings, soil	tailings, soil
Public water supply users; Atkinson well water	248	groundwater	groundwater?	
Public water supply users; High Valley well water	250	groundwater	groundwater	
Public water supply users; Summit Co. #3 well water	75		groundwater?	

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TABLE 15 ESTIMATED POPULATION FOR COMPLETED EXPOSURE PATHWAYS

Estimated Exposed Populations		Contaminants and Media:		
Location	**Number**	**copper**	**iron**	**lead**
Tailings workers	unknown	surface water, tailings, soil	surface water, tailings, soil	air, soil, surface water, tailings,
Site trespassers	unknown	tailings, soil	tailings, soil	tailings, air, soil
Public water supply users; Atkinson well water	248	groundwater?	groundwater	groundwater?
Public water supply users; High Valley well water	250	groundwater	groundwater	groundwater?
Public water supply users; Summit Co. #3 well water	75	groundwater	groundwater	groundwater?

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TABLE 15 ESTIMATED POPULATION FOR COMPLETED EXPOSURE PATHWAYS

Estimated Exposed Populations		Contaminants and Media:		
Location	**Number**	**magnesium**	**manganese**	**mercury**
Tailings workers	unknown	surface water, tailings, soil	surface water, tailings, soil	surface water tailings, soil
Site trespassers	unknown	tailings, soil	tailings, soil	tailings, soil
Public water supply users; Atkinson well water	248	groundwater	groundwater	groundwater
Public water supply users; High Valley well water	250	groundwater	groundwater	groundwater?
Public water supply users; Summit Co. #3 well water	75	groundwater	groundwater	groundwater?

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TABLE 15 ESTIMATED POPULATION FOR COMPLETED EXPOSURE PATHWAYS

Estimated Exposed Populations		Contaminants and Media:		
Location	**Number**	**nickel**	**potassium**	**silver**
Tailings workers	unknown	surface water, tailings, soil	surface water, tailings, soil	surface water, tailings, soil
Site trespassers	unknown	tailings, soil	tailings, soil	tailings, soil
Public water supply users; Atkinson well water	248	groundwater?	groundwater	groundwater?
Public water supply users; High Valley well water	250		groundwater	groundwater?
Public water supply users; Summit Co. #3 well water	75	groundwater?	groundwater	groundwater?

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TABLE 15 ESTIMATED POPULATION FOR COMPLETED EXPOSURE PATHWAYS

Estimated Exposed Populations		Contaminants and Media:		
Location	Number	sodium	thallium	vanadium
Tailings workers	unknown	surface water, tailings, soil	surface water, tailings, soil	surface water, tailings, soil
Site trespassers	unknown	tailings, soil	tailings, soil	tailings, soil
Public water supply users; Atkinson well water	248	groundwater		
Public water supply users; High Valley well water	250	groundwater		
Public water supply users; Summit Co. #3 well water	75	groundwater		

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TABLE 15 ESTIMATED POPULATION FOR COMPLETED EXPOSURE PATHWAYS

Estimated Exposed Populations		Contaminants and Media:		
Location	**Number**	**zinc**		
Tailings workers	unknown	surface water, air, tailings, soil		
Site trespassers	unknown	tailings, soil, air		
Public water supply users; Atkinson well water	248	groundwater		
Public water supply users; High Valley well water	250	groundwater		
Public water supply users; Summit Co. #3 well water	75	groundwater		

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TABLE 16 ESTIMATED POPULATION FOR POTENTIAL EXPOSURE PATHWAYS

Estimated Potentially Exposed Populations		Contaminants and Media:		
Location	Number	aluminum	antimony	arsenic
Site maintenance or remediation workers; or future residents & workers	unknown	surface water, tailings, soil	surface water, tailings, soil	air, soil, surface water, tailings
Site treespassers	unknown	tailings, soil	tailings, soil	tailings, soil
Area residents	unknown	soil, sediment, surface water	soil, sediment, surface water	soil, sediment, surface water, air
Nearest residents *	10			
Nearest workers, 3 companies	50	soil	soil	soil, groundwater, air
Road maintenance workers, Rt. 40 constructors	unknown	soil, sediment, surface water, tailings	soil, sediment, surface water, tailings	soil, sediment, surface water, sediment, air
Fishermen, families **	unknown			
Ranchers ***	unknown	surface water, sediment, tailings	surface water, sediment, tailings	surface water, sediment, air, tailings

?- indicates uncertainty whether a specific contaminant is present in medium and pathway
*- no sampling data to confirm whether residents' well water contains any contaminants
**- no sampling data to confirm whether fish contain any contaminants
***- no sampling data to confirm whether agricultural products contain any contaminants
Sheet 1 of 8

TABLE 16 ESTIMATED POPULATION FOR POTENTIAL EXPOSURE PATHWAYS

Estimated Potentially Exposed Populations		Contaminants and Media:		
Location	**Number**	**barium**	**beryllium**	**cadmium**
Site maintenance or remediation workers, or future residents & workers	unknown	surface water, tailings, soil	surface water, tailings, soil	air, soil, surface water, tailings
Site trespassers	unknown	tailings, soil	tailings, soil	tailings, soil
Area residents	unknown	soil, sediment, surface water	soil, sediment, surface water	soil, sediment, surface water, air
Nearest residents *	10			
Nearest workers, 3 companies	50	soil	soil	soil, air
Road maintenance workers, Rt. 40 constructors	unknown	soil, sediment, surface water, tailings	soil, sediment, surface water, tailings	soil, sediment, surface water, tailings, air
Fishermen, families **	unknown			
Ranchers ***	unknown	surface water, sediment, tailings	surface water, sediment, tailings	surface water, sediment, air, tailings

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TABLE 16 ESTIMATED POPULATION FOR POTENTIAL EXPOSURE PATHWAYS

Estimated Potentially Exposed Populations		Contaminants and Media:		
Location	Number	calcium	chromium	cobalt
Site maintenance or remediation workers; or future residents & workers	unknown	surface water, tailings, soil	surface water, tailings, soil	surface water, tailings, soil
Site trespassers	unknown	tailings, soil	tailings, soil	tailings, soil
Area residents	unknown	soil, sediment, surface water	soil, sediment, surface water	soil, sediment, surface water
Nearest residents *	10			
Nearest workers, 3 companies	50	soil	soil	soil
Road maintenance workers, Rt. 40 constructors	unknown	soil, sediment, surface water, tailings	soil, sediment, surface water, tailings	soil, sediment, surface water, tailings
Fishermen, families **	unknown			
Ranchers ***	unknown	surface water, sediment, tailings	surface water, sediment, tailings	surface water, sediment, tailings

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TABLE 16 ESTIMATED POPULATION FOR POTENTIAL EXPOSURE PATHWAYS

Estimated Potentially Exposed Populations		Contaminants and Media:		
Location	**Number**	**copper**	**iron**	**lead**
Site maintenance or remediation workers; or future residents & workers	unknown	surface water, tailings, soil	surface water, tailings, soil	air, soil, surface water, tailings
Site trespassers	unknown	tailings, soil	tailings, soil	tailings, soil
Area residents	unknown	soil, sediment, surface water	soil, sediment, surface water	soil, sediment, surface water, air
Nearest residents *	10			
Nearest workers, 3 companies	50	soil	soil	soil, groundwater, air
Road maintenance workers, Rt. 40 constructors	unknown	soil, sediment, surface water, tailings	soil, sediment, surface water, tailings	soil, sediment, surface water, tailings, air
Fishermen, families **	unknown			
Ranchers ***	unknown	surface water, sediment, tailings	surface water, sediment, tailings	surface water, sediment, air, tailings

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TABLE 16 ESTIMATED POPULATION FOR POTENTIAL EXPOSURE PATHWAYS

Estimated Potentially Exposed Populations		Contaminants and Media:		
Location	**Number**	**magnesium**	**manganese**	**mercury**
Site maintenance or remediation workers; or future residents & workers	unknown	surface water, tailings, soil	surface water, tailings, soil	surface water, tailings, soil
Site trespassers	unknown	tailings, soil	tailings, soil	tailings, soil
Area residents	unknown	soil, sediment, surface water	soil, sediment, surface water	soil, sediment, surface water
Nearest residents *	10			
Nearest workers, 3 companies	50	soil	soil	soil
Road maintenance workers, Rt. 40 constructors	unknown	soil, sediment, surface water, tailings	soil, sediment, surface water, tailings	soil, sediment, surface water, tailings
Fishermen, families **	unknown			
Ranchers ***	unknown	surface water, sediment, tailings	surface water, sediment, tailings	surface water, sediment, tailings

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TABLE 16 ESTIMATED POPULATION FOR POTENTIAL EXPOSURE PATHWAYS

Estimated Potentially Exposed Populations		Contaminants and Media:		
Location	Number	nickel	potassium	silver
Site maintenance or remediation workers; or future residents & workers	unknown	surface water, tailings, soil	surface water, tailings, soil	surface water, tailings, soil
Site trespassers	unknown	tailings, soil	tailings, soil	tailings, soil
Area residents	unknown	soil, sediment, surface water	soil, sediment, surface water	soil, sediment, surface water
Nearest residents *	10			
Nearest workers, 3 companies	50	soil	soil	soil
Road maintenance workers, Rt. 40 constructors	unknown	soil, sediment, surface water, tailings	soil, sediment, surface water, tailings	soil, sediment, surface water, tailings
Fishermen, families **	unknown			
Ranchers ***	unknown	surface water, sediment, tailings	surface water, sediment, tailings	surface water, sediment, tailings

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TABLE 16 ESTIMATED POPULATION FOR POTENTIAL EXPOSURE PATHWAYS

Estimated Potentially Exposed Populations		Contaminants and Media:		
Location	**Number**	**sodium**	**thallium**	**vanadium**
Site maintenance or remediation workers; or future residents & workers	unknown	surface water, tailings, soil	surface water, tailings, soil	surface water, tailings, soil
Site trespassers	unknown	tailings, soil	tailings, soil	tailings, soil
Area residents	unknown	soil, sediment, surface water	soil, sediment, surface water?	soil, sediment, surface water?
Nearest residents *	10			
Nearest workers, 3 companies	50	soil	soil	soil
Road maintenance workers, Rt. 40 constructors	unknown	soil, sediment, surface water, tailings	soil, sediment, surface water, tailings	soil, sediment, surface water, tailings
Fishermen, families **	unknown			
Ranchers ***	unknown	surface water, sediment, tailings	surface water, sediment, tailings	surface water, sediment, tailings

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TABLE 16 ESTIMATED POPULATION FOR POTENTIAL EXPOSURE PATHWAYS

Estimated Potentially Exposed Populations		Contaminants and Media:		
Location	**Number**	**zinc**		
Site maintenance or remediation workers; or future residents & workers	unknown	air, surface water, tailings, soil		
Site trespassers	unknown	tailings, soil		
Area residents	unknown	soil, sediment, surface water, air		
Nearest residents *	10			
Nearest workers, 3 companies	50	soil, air		
Road maintenance workers, Rt. 40 constructors	unknown	soil, sediment, air, surface water, tailings		
Fishermen, families **	unknown			
Ranchers ***	unknown	surface water, sediment, air, tailings		

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RICHARDSON FLATS TAILINGS PRELIM. PHA ADD. PUBLIC COMMENT RELEASE

APPENDIX C

ATSDR PRELIMINARY PUBLIC HEALTH ASSESSMENT OF 1990

RICHARDSON FLATS TAILINGS PRELIM. PHA ADD. PUBLIC COMMENT RELEASE

Health Assessment

RICHARDSON FLAT TAILINGS SITE

PARK CITY, SUMMIT COUNTY, UTAH

CERCLIS No. UTD980952840

July 24, 1990

RICHARDSON FLATS TAILINGS PRELIM. PHA ADD. PUBLIC COMMENT RELEASE

SUMMARY

The Richardson Flat Tailings, an Update 7 site proposed for the National Priorities List, is located 3.5 miles northeast of Park City, Summit County, Utah. From 1975 to 1981, the 160-acre site was used for disposing mine tailing wastes from the Keetly Ontario Mine and other mines owned by United Park City Mines. Currently no tailings are dumped at the site; however, soil from the site is being excavated and used to cover the tailings piles. Several metal contaminants, including arsenic, cadmium, chromium, lead, and zinc, have been detected in on-site and off-site areas. Contaminants may migrate from the site to off-site areas through surface water, groundwater, and airborne-associated pathways. Human exposure to site contaminants may occur through the ingestion of contaminated groundwater, food-chain entities, and soil; through dermal contact with contaminants; and through the inhalation of airborne dusts. The site is considered to be of potential public health concern because of the high levels of on-site contaminants.

BACKGROUND

A. Site Description and History

The Richardson Flat Tailings site (RFT), consisting of 160 acres located in a topographic depression approximately 3.5 miles northeast of Park City, in Summit County, Utah, is an Update 7 site proposed for the National Priorities List (NPL) (see Figures 1 and 2). From 1975 until 1981, mine tailings from the Keetly Ontario Mine and other mining operations in the area were disposed of at the site and currently range up to 10 feet in depth. Until 1987, mine tailings were removed from the site and used as backfill for sewer construction projects.

Currently, mine tailings at the site are being covered by soil excavated from on-site areas. The thickness of the soil cover varies over the surface of the site, and, as noted during the April 1989 site visit, the soil layer covering the mine tailings was less than 1-inch thick in certain areas. Site features include a pond that covers the northeastern corner of the site and is contained by a dam at the northwestern corner, and a ditch in the central portion of the site.

B. Site Visit

Staff from the Agency for Toxic Substances and Disease Registry (ATSDR) and the Utah Department of Health conducted a visit to the RFT site on April 19, 1989. During the site visit, conditions on-site and off-site were observed, including land uses in areas adjacent to the site, the proximity of residential areas to the site, the ease of site access, the presence of on-site physical hazards, and the general physical characteristics of the site. Specific observations made during the site visit will be discussed in appropriate sections of this Preliminary Health Assessment.

C. Community Health Concerns

Staff from the Utah Department of Health indicated that they were not aware of any community health concerns related to the RFT site.

DEMOGRAPHICS, LAND USE, AND NATURAL RESOURCE USE

The site lies in a rural area with very widely scattered residences. It is within 1.5 miles of Prospector Square, which is an extension of Park City, a popular recreational and ski area of Utah. The area within a 1-mile radius of the site consists of open, undeveloped rangeland and agricultural fields. Only three residences are within a 1-mile radius of the site; however, because the site is close to a popular resort, which has expanded in recent years, future development of the area may increase residential, commercial, and recreational land uses (1).

Recreational land uses in the site vicinity include fishing in Silver Creek, a popular stream for trout fishing, and downhill skiing at nearby ski slopes. Piles of mine tailings on-site are commonly used for unauthorized recreational motorcycling.

Other land uses in the site vicinity include pastureland for cattle and sheep and land parcels used for cultivating hay and grain. No industrial or commercial land uses are within 1-mile of the site.

ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS

A. On-Site and Off-Site Contamination

Monitoring results were analyzed for groundwater, surface water, soil, and air samples collected during initial site investigations conducted in 1985. These results are only of preliminary and are not sufficient to characterize the full nature and extent of site contamination.

1. Groundwater

Groundwater samples were collected from monitoring wells located upgradient and downgradient from the site. Groundwater samples were analyzed for total metals, cyanide, sulfate, and dissolved metals. The highest concentrations of contaminants were detected in unfiltered groundwater samples collected from monitoring wells located downgradient from the site (see Table 1).

Table 1.
Groundwater*, 1985

Contaminant	Maximum Concentration [ppb] Off-Site Upgradient	On-Site	Drinking Water Criteria+
Arsenic	<5	349	50
Cadmium	<5	48	10
Chromium	<5	104	50
Lead	<30	1,080	20#
Manganese	20	10,400	50

*Unfiltered samples.
+National Interim Primary Drinking Water Regulations. U.S. Environmental Protection Agency, Office of Drinking Water, 1976.
#Proposed Maximum Contaminant Level at the tap.

2. Surface Water

Surface water samples were collected from the east bank of Silver Creek and from an intermittent stream that flows through the tailings. Surface water samples were analyzed for total metals and sulfate. The highest contaminant levels in Silver Creek were found immediately downstream from the site and at the discharge point for the intermittent, on-site stream (see Table 2). Approximately 2 miles upstream from the RFT site, the Prospector Square tailings may also serve as an important source of surface water contaminants.

Table 2.
Surface Water, 1986

Contaminant	Maximum Concentration [ppb] Upstream Silver Creek	Downstream Silver Creek
Arsenic	14	65
Copper	12	60
Lead	147	1,985

3. Soil

Samples of surface and subsurface soil were collected from on-site and off-site areas (see Table 3 and 4). Soil samples were analyzed for total metals. Samples of subsurface, on-site soil samples (tailings) were analyzed for total metals and cyanide. Results of analyses of on-site surface soil (tailings) and off-site surface soil indicate levels of arsenic, cadmium,

lead, and zinc substantially higher than the mean concentrations for the western United States.

Results of sample analyses of subsurface mine tailings indicated elevated levels of heavy metals and arsenic (see Table 4). Off-site, subsurface samples did not have contaminant levels above mean concentrations for the western United States, indicating the likelihood that off-site soil contamination is generally limited to the upper portions of the soil profile (2).

Table 3.
Surface Soil and Tailings, 1986

Maximum Concentration [ppb]

	Background*	On-Site	Mean for Western U.S.
Arsenic	58,000	3,600,000	5,500
Cadmium	17,000	80,000	200
Lead	1,110,000	8,530,000	17,000
Selenium	6,700	<400,000	230
Zinc	1,570,000	6.360,000	55,000

*Levels reported as background may not be true background because they were collected adjacent to the site and in an area with a history of mining activity.

Table 4.
Subsurface Soil and Tailings, 1986

Maximum Concentrations [ppb]

Contaminant	Background*	On-Site	Mean for Western U.S.
Arsenic	6,500	328,000	5,500
Cadmium	7,400	169,000	200
Lead	37,000	4,920,000	17,000
Selenium	<100	9,400	230
Zinc	70,000	23,200,000	55,000

*Levels reported as background may not be true background because they were collected adjacent to the site and in an area with a history of mining activity.

4. Air

Preliminary air monitoring was conducted using five high-volume air samplers at four sampling locations over a 5-day period. Air samples were analyzed for arsenic, cadmium, lead, and zinc. During air monitoring, weather conditions were dry with winds varying up to 20 miles per hour, although winds gusted up to 40 miles per hour during the first day of sample collection. The highest levels of airborne contaminants were detected during the

first day of sampling at the air monitoring station downwind from the site (see Table 5). Air monitoring results verify that releases of airborne contaminants have occurred at the RFT site.

Table 5.
Air, 1986

Maximum Concentration [micrograms per cubic meter]

Contaminant	Upwind	Downwind
Arsenic	0.002	0.093
Cadmium	< 0.010*	0.082*
Lead	0.103	1.648
Zinc	0.091+	1.155+

*Matrix spike recovery was 65% for cadmium; actual value may be higher.
+Matrix spike recovery was 60% for zinc; values given are estimates.

B. Quality Assurance and Quality Control

Quality assurance and quality control procedures were used to ensure the accuracy of the monitoring programs conducted during site investigations at the RFT site. Sample collection and analyses were determined to have been performed according to approved procedures; therefore, monitoring results were determined to be acceptable. The conclusions contained in this report are based on the data package supplied to ATSDR. The accuracy of these conclusions depends on the reliability and comprehensiveness of the data contained in the materials reviewed.

C. Physical and Other Hazards

No on-site physical hazards were noted during the site visit.

PATHWAYS ANALYSES

A. Environmental Pathways (Fate and Transport)

1. Groundwater

Groundwater was encountered within 12 feet of the site's surface during the collection of on-site soil samples. In the site vicinity, the uppermost aquifer, with an average depth of 60 feet, lies within alluvial deposits overlying consolidated rocks of tertiary origin. It is not clear whether this alluvial aquifer is hydrologically connected to the deeper aquifer found in the consolidated rock formation. Groundwater flow beneath the site and in the site vicinity is to the north-northwest.

No private or monitoring wells are on-site. Two private domestic wells are located about 4,000 feet southwest of the site. Both of these wells are completed to a depth of about 210 feet below the ground's surface. A single municipal well used as a backup source for the Park City municipal water system is located 2.5 miles southwest of the RFT site (1). Groundwater samples were not collected from the above-mentioned private and municipal wells; however, because these wells are located upgradient from the site, they are not expected to be impacted by site contaminants.

2. Surface Water

Surface water and leachate from the site may transport site contaminants into nearby streams and creeks. The largest surface water feature in the site vicinity is Silver Creek, located about 200 feet west of the site. Approximately 1,000 feet downstream from the site, surface water from Silver Creek is diverted for the irrigation of pastureland and hay fields. Silver Creek does not serve as a source of drinking water source for humans.

Several leachate (mine tailing drainage) seeps were noted on the northwest side of the on-site earth dam; however, surface water samples were not collected in this area. These seeps flow from the site to the northwest into a swampy area that drains into Silver Creek. Leachate from the mine tailings pile may serve as an important source of surface water contamination.

3. Soil

Mine tailings consist of finely crushed rock that are easily eroded by surface water runoff and wind. Erosion of the mine tailings is likely because portions of the mine tailing piles are uncovered and lack a vegetative cover. Although a soil cover is being placed over the surface of the mine tailings, the thickness of the cover varies considerably and may be less than 1 inch. Soil used to cover the tailings may also be contaminated because it is being excavated from on-site areas in which mine tailings were dumped. The soil covering the tailings is expected to have a minimal impact on the migration of tailing contaminants into groundwater.
As precipitation percolates through the mine tailings, sulfates in the tailings dissolve, increasing the acidity of water as it seeps downward. As infiltrating water becomes more acidic, it dissolves the arsenic and heavy metal compounds in the tailings and carries these contaminants downward. Monitoring results indicate that contaminants have already migrated to lower levels of the tailing piles and impacted local groundwater and nearby surface waters. Contaminants will continue to impact groundwater and surface water if no remediation is performed.

4. Air

The small particle size of the tailings increases the likelihood that wind may be an important mechanism for dust transport to off-site areas. Site documents indicate that releases of

windblown contaminants to off-site areas have been observed, especially in the summer months when winds from the southwest blow dust from the site across Interstate 40.

5. Contaminated Food-Chain Entities

Site contaminants may bioaccumulate in food-chain entities. In the site vicinity, approximately 315 acres of agricultural land are irrigated with surface water diverted from Silver Creek. Irrigated lands are used for pastureland and the production of grains and hay. Crops irrigated with contaminated surface water may bioaccumulate contaminants.

Animals may also become contaminated if they graze in areas impacted by the site, feed on crops irrigated with contaminated water, or ingest contaminated surface water, soil, or sediments. Cattle and sheep are known to graze in shrub land adjacent to the site.

Fish from Silver Creek may also bioaccumulate contaminants from surface water and sediment. Silver Creek is known to support recreational trout fishing.

B. Human Exposure Pathways

Several potential routes exist by which humans may be exposed to contaminants from the RFT site. Ingestion of contaminated groundwater, soil, and food-chain entities and inhalation of dust are all potential routes of human contaminant exposure.

1. Soil - and Tailings-Associated Pathways

Ingestion, inhalation, and dermal exposures to soil and tailings may adversely impact human health. The highest contaminant levels were found in on-site subsurface soil and tailings; however, on-site and off-site surface soil and tailings were also contaminated. The site is located in a rural area and because access to it is not restricted, trespassers may come in contact with these contaminated media during cycling or other activities on or near the site.

2. Groundwater-Associated Pathways

Human exposure to groundwater contaminants may result from the use of contaminated groundwater for domestic, industrial, and agricultural purposes. Local residents are known to rely on groundwater as a potable water supply; however, monitoring data for off-site groundwater are limited to results from a single upgradient well and two downgradient wells. The likelihood of human exposure to groundwater contaminants is minimized by the rural nature of the site and the lack of supply wells for potable water downgradient from the site; however, without monitoring results from nearby private wells, this pathway of human exposure can not be ignored. The potential exists for completing this

pathway of human exposure in the future if groundwater wells are installed on-site or downgradient from the site.

3. Food-Chain-Associated Pathways

Another potential pathway for human exposure to contaminants is through the consumption of food-chain entities that may bioaccumulate contaminants. Cultivated grains and vegetables and other edible plants may bioaccumulate soil contaminants and result in food-chain contamination. Cattle, sheep, and wildlife that consume contaminated plant material or surface water may also bioaccumulate contaminants.

Aquatic animals, such as trout in Silver Creek, that inhabit contaminated surface water or aquatic systems with contaminated sediments may also bioaccumulate contaminants. Analytical results of surface water samples collected from Silver Creek indicate contaminants at levels significantly in excess of Federal Ambient Water Quality Criteria. These contaminants are known to bioaccumulate in fish and may reach levels that make Silver Creek trout unsuitable for human consumption.

4. Airborne-Associated Pathways

Inhalation of contaminated dusts may be a human exposure pathway. On-site activities, including cycling, soil remediation, or excavation of tailings for use as fill may result in the generation of dust and the exposure of motorcyclists, on-site workers, and area residents to site contaminants. The relative remoteness of the site may help reduce the impact of this pathway of human exposure.

5. Surface-Water-Associated Pathways

Surface water obtained from local sources is not a source of drinking water within the site vicinity; however, surface water is used to irrigate pastureland and hay and grain fields. As a result, human exposure to site-related contaminants may result from the ingestion of contaminated grains, animal products, or fish.

PUBLIC HEALTH IMPLICATIONS

Results of preliminary groundwater and soil sampling indicate that the RFT site is of potential public health concern because of contaminants in on-site air, soil, mine tailings, and groundwater and on-site and off-site surface water and sediments.

A brief discussion of the identified site contaminants of public health concern follows.

Arsenic

Human exposure to arsenic is possible through three major pathways: ingestion, inhalation, and dermal contact. Common

effects from ingestion of arsenic include irritation of the digestive tract leading to pain, nausea, vomiting, and diarrhea. Ingestion of inorganic arsenic, the form most likely found at the RFT site, also causes a pattern of skin abnormalities, such as dark and light spots on the skin and small "corns" on the palms, soles, and trunk. Some of the corns may progress to skin cancer. Other health effects of arsenic ingestion include an increased risk of liver, bladder, kidney, and lung cancer. Long-term exposure (greater than 14 days) to inorganic arsenic at levels as low as 20 micrograms per kilogram of body weight per day may result in mild health effects. The severity of symptoms tends to increase as exposure duration increases. The Environmental Protection Agency (EPA) estimates that a dose of 1 microgram per kilogram of body weight per day corresponds to a cancer risk of 1.5 in 1,000 (3). Arsenic levels are sufficiently high in surface soil to be of public health concern for ingestion, inhalation, or dermal exposures.

Inhalation of inorganic arsenic dusts may also result in mild irritation of the digestive tract. The inhalation route of human exposure is more likely to increase the risk of lung cancer than is the ingestion route. Air concentrations of about 200 micrograms per cubic meter are associated with irritation of the nose, throat, and exposed skin. The National Institute for Occupational Safety and Health (NIOSH) has set a recommended exposure limit (REL) for occupational exposure to arsenic in air at 2 micrograms per cubic meter not to be exceeded for more than 15-minutes. EPA has estimated that a lifetime inhalation exposure to 1 microgram per cubic meter causes a lifetime cancer risk of 4 in 1,000 (3). The maximum level of airborne arsenic detected at the RFT site (0.093 micrograms per cubic meter) is at a level of public health concern. Soil-disturbing activities, such as excavation of soils or motorcycling, are likely to cause an increase in airborne arsenic levels.

Dermal exposure to arsenic-containing compounds may result in mild-to-severe irritation of the skin, eyes, or throat. No reliable dose estimates are available on the exposure levels at which these effects begin to appear.

Cadmium

Human exposure to cadmium at the RFT site can occur either through the ingestion of contaminated soil, mine tailings, and food-chain entities or through the inhalation of contaminated dusts. Very small amounts of ingested cadmium are absorbed into the blood (1%-5%) while 30%-50% of that which is inhaled is taken into the blood (4). Once cadmium enters the body, it is retained very strongly. A proposed reference dose (a daily dose that is estimated to be without appreciable human health risk) of 0.5 micrograms per kilogram of body weight per day for oral exposure is currently under review (4).

Ingestion of cadmium may result in damage to the kidneys and may cause hypertension, although the importance of cadmium in

hypertension is unclear. Dermal exposure to cadmium compounds has not been observed to cause significant health effects. Long-term inhalation exposures to cadmium at levels of 100 micrograms per cubic meter may increase the risk of lung disease, such as emphysema, and may also cause kidney injury. Lifelong inhalation of air containing 0.03 micrograms per cubic meter is estimated to cause a lifetime cancer risk of 1 in 10,000 (4). Air monitoring results at the RFT site detected airborne cadmium levels (0.082 microgram per cubic meter) at levels of public health concern (1). Site remediation activities or on-site cycling activities are likely to increase airborne cadmium levels.

Under current land use, cadmium levels in surface soil are not high enough to be of public health concern. If the site is developed for residential or recreational uses, the levels may become a public health concern.

Lead

Human exposure to lead at the RFT site may occur through two major pathways: the ingestion of contaminated soil, mine tailings, and food-chain entities or the inhalation of airborne contaminated dusts. Levels of lead in surface soil and tailings, subsurface soil and tailings, and air are sufficiently high to be of public health concern.

Children are especially susceptible to the health effects of lead exposure. Low levels of lead exposure may cause decreased growth and may result in lower intelligence quotient (IQ) scores. Low levels of lead exposure may also cause hypertension in middle-aged men. Pregnant women exposed to lead transfer lead to the fetus, and this may cause preterm birth, reduced birth weight, and decreased neurological development in the infant. Results of studies have shown that lead causes cancer in laboratory animals; however, it is not known whether lead causes cancer in humans.

Human inhalation of lead-contaminated dust or lead fumes may result in the same health effects that ingestion exposure causes. Air monitoring results at the RFT site indicated lead (1.65 micrograms per cubic meter) at levels above EPA's National Primary and Secondary Ambient Air Quality Standards for lead (1.5 micrograms per cubic meter) (5). Airborne lead levels are expected to be even higher if soil is disturbed by on-site activities such as soil excavating or cycling.

The Centers for Disease Control (CDC) has cautioned that concentrations of lead greater than 500-1,000 parts per million (ppm) in residential soil could lead to elevated blood lead levels in children who inhale or ingest soil. Lead levels in excess of these values were found in on-site surface soil and mine tailings and in subsurface soil and tailings. Site trespassers, site workers, and recreational cyclists may experience short-term exposures to lead-contaminated media.

Selenium

Human exposure to selenium at the RFT site may occur through the ingestion of contaminated groundwater or soil and through the inhalation of airborne dust. Once ingested, selenium in both the organic and inorganic forms is readily absorbed. Although selenium is an essential nutrient, it may have toxic effects at levels moderately above the daily nutritional requirement. The Food and Nutrition Board of the National Academy of Sciences (NAS) suggests that 0.05 to 0.20 mg of selenium per person per day is an adequate and safe level of dietary intake in adults (6).

Inhalation of selenium may cause damage to the respiratory tract, gastrointestinal and cardiovascular effects, and irritation of the skin and eyes (7). Air samples collected from the RFT site were not analyzed for selenium; however, the levels found in surface soil and tailings and the air monitoring results for other site contaminants indicate that airborne selenium levels may be of public health concern under normal site conditions. Soil disruption by such activities as soil excavation or cycling could increase airborne selenium levels.

Selenium may also bioaccumulate in plants and animals. The health effects from long-term exposure to selenium via ingestion of contaminated food or water include loss of hair, loss and deformities of nails, problems with walking, diminished reflexes, and some paralysis. These health effects were reported from a study of populations in China that lived in areas with extremely high selenium levels in the soil and in the rice and vegetables they consumed. Selenium levels in the food were 1.6 parts per million or higher, and the period of exposure was months or even years (8).

Zinc

Human exposure to zinc at the RFT site may occur through two major pathways: the ingestion of contaminated soil, tailings, and groundwater or the inhalation of airborne contaminated dust. Which health effects result from exposure to excess levels of zinc depends on the pathway of exposure.

Ingestion of excess zinc may cause stomach or digestive problems. NAS has estimated the recommended dietary allowance (RDA) for zinc to be 15 milligrams per day (6). Long-term exposure to excessive levels of zinc (2.1 milligrams per kilogram of body weight per day) may result in copper deficiency (8); however, exposures of this magnitude are not expected to occur at the RFT site.

Inhalation of zinc dust may lead to breathing difficulties and nonspecific neurological effects such as headaches and malaise (9). Air monitoring results at the RFT site did not show zinc to be at levels of public health concern; however, during soil-disturbing activities, such as soil excavation or cycling, airborne zinc levels may become a public health concern.

CONCLUSIONS

Using the available information, ATSDR has concluded that this site is of potential public health concern because humans may be exposed to hazardous substances by ingestion of contaminated soil, groundwater, and food-chain entities; dermal contact with contaminated soil; and inhalation of contaminated dust. This Preliminary Health Assessment is based on incomplete monitoring data for groundwater and surface water. A full assessment of the public health implications of this site is not possible with the information presently available.
In accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, the Richardson Flat Tailings site has been evaluated for possible follow-up with health effects studies. However, because no documentation or indication exists that human exposure to site-related contaminants is occurring or has occurred in the past, this site is not being considered for follow-up health studies at this time.

As ATSDR receives additional information, such information may indicate that further assessment is warranted by site-specific public health issues.

RECOMMENDATIONS

ATSDR recommends the following:

1. Restrict public access to the site to reduce unauthorized site entry and use of the site for recreational purposes.

2. Monitor private wells within 1 mile of the site to determine whether these wells are being impacted by site contaminants and whether water from these wells can continue to be used for potable purposes.

3. Conduct additional surface water monitoring, both upgradient and downgradient from the site, to determine the site's impact on Silver Creek and other nearby bodies of surface water.

4. Sample leachate seeps from along the north side of the on-site earthen dam, and analyze these samples for site-associated contaminants.

5. Collect additional off-site soil samples from areas adjacent to the site, especially downwind of the site, to characterize off-site contamination.

6. Collect and analyze edible portions of trout from Silver Creek to determine whether they are suitable for continued human consumption.

7. Include the following in the remediation workplan if additional site remediation occurs:

   Provide adequate personal protective equipment that meets the standards of the Occupational Safety and Health Administration (OSHA) for workers conducting remedial activities in and around the site.

   Follow appropriate precautionary guidelines, regulations, and advisories from the National Institute for Occupational Safety and Health (NIOSH) and OSHA.

   Employ optimal dust control measures if remedial activities will involve ground-disturbing activities. In addition to on-site air monitoring, appropriate real-time air monitoring at the worksite periphery should be conducted during working hours in addition to on-site air monitoring. Levels of contaminants in the ambient air at the periphery of the site should not exceed National Ambient Air Quality Standards (NAAQS) or NIOSH recommendations.

8. When indicated by public health needs, and as resources permit, the evaluation of additional relevant health outcome data and community health concerns, if available, is recommended.

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APPENDIX

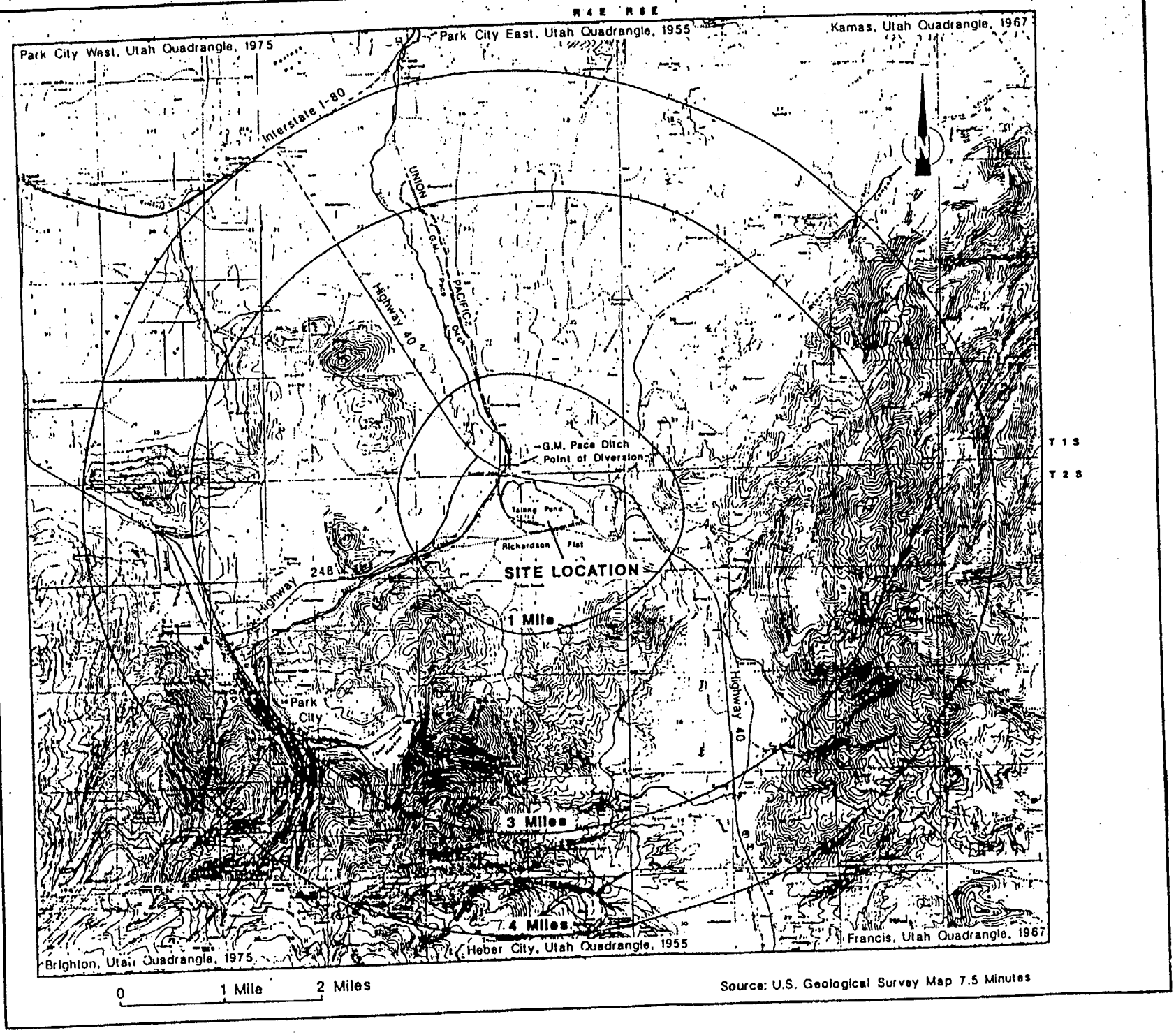
R4E R5E
Park City West, Utah Quadrangle, 1975
Park City East, Utah Quadrangle, 1955
Kamas, Utah Quadrangle, 1967
Interstate I-80
UNION
G.M.
Pace
PACIFIC
Ditch
Highway 40
G.M. Pace Ditch
Point of Diversion
T 1 S
T 2 S
Tailing Pond
Richardson Flat
SITE LOCATION
Highway 248
1 Mile
Park City
Highway 40
3 Miles
7.4 Miles
Brighton, Utah Quadrangle, 1975
Heber City, Utah Quadrangle, 1955
Francis, Utah Quadrangle, 1967
0
1 Mile
2 Miles
Source: U.S. Geological Survey Map 7.5 Minutes

FIGURE I

FIGURE II